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TRANSACTIONS
OF THE
ROYAL SOCIETY OF EDINBURGH.

VOL. III.



EDINBURGH:

PRINTED FOR T. CADELL, IN THE STRAND, LONDON;

AND

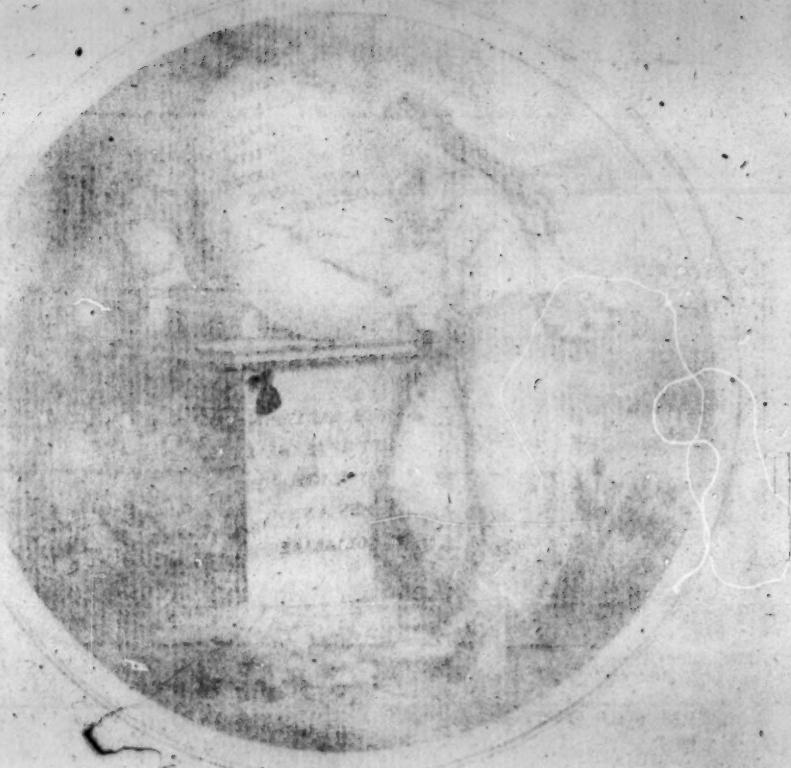
J. DICKSON, AND E. BALFOUR, EDINBURGH.

MDCCLXIV.

TRANSACTIONS

ROYAL SOCIETY OF EDINBURGH

VOLUME III.



EDINBURGH
PRINTED FOR THE SOCIETY
BY JAMES AND J. DODD, EDINBURGH.
MDCCLXVII.



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THIRD VOLUME.

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TRANS.

C O M T E M T S

X. The author of the original manuscript, Dr. George, is Dr. Alexander
Scholes.

XI. The author of the original manuscript, Dr. Alexander, is Dr. Alexander
Scholes.

XII. A description of an audience of Dr. Scholes.
Dr. Scholes.

XIII. Description of an audience of Dr. Scholes.
Dr. Scholes.

II

LESSON OF THE LITTLE GIRL CLASS.

1. The author of the original manuscript, Dr. Alexander, is Dr. Alexander
Scholes.

2. The author of the original manuscript, Dr. Alexander, is Dr. Alexander
Scholes.

W.A.T.

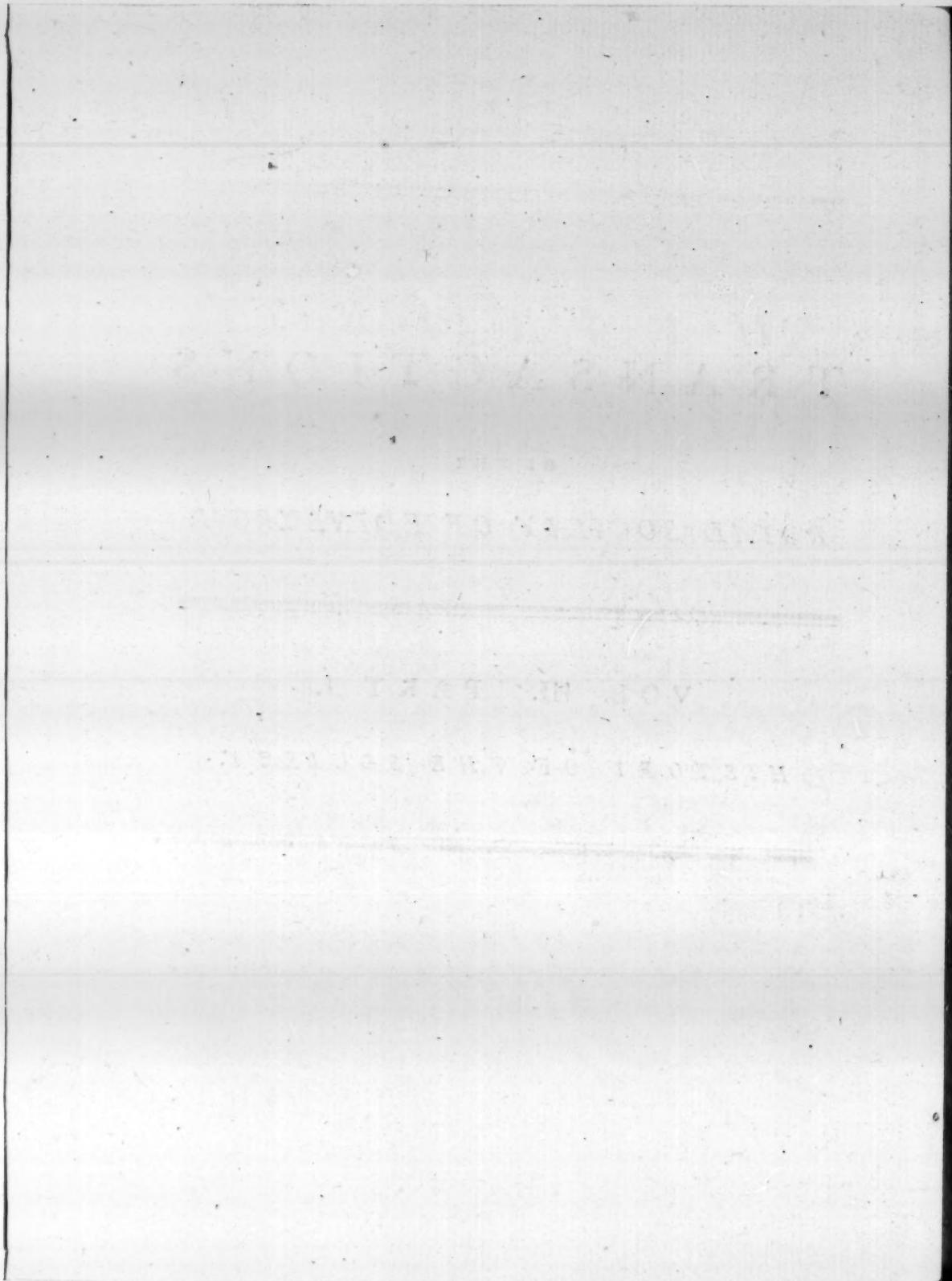
TRANSACTIONS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. III. PART I.

HISTORY OF THE SOCIETY.



H I S T O R Y

O F

T H E S O C I E T Y.

PHYSICAL Clas. A paper on the Cause of Heat in Chemical mixtures, formerly read in the Philosophical Society, was communicated by Dr GARDNER. Mr ROBERT KERR read an Essay on the Origin of the Heat and Light in Deflation.

1789.
Jan. 5.
On the cause of
heat in chemical
mixtures.

A GENERAL Meeting of the Royal Society was held for the election of Members, [See the List in the Appendix to the History of the Society, Vol. II.]

Jan. 26.
General Meet-
ing.

Phyf. Cl. A BIOGRAPHICAL account of the late Dr WILSON, Professor of Astronomy in the University of Glasgow, was
(A 2) read;

Feb. 2.
Biographical
account of Dr
Wilson.

1789.

read; communicated by his son Mr PATRICK WILSON, the present Professor of Astronomy in that University.

March 2.

Mr Playfair on the astronomy of the Brahmins.

March 16.

Biographical account of Sir William Dick.

Phys. Cl. Mr Professor PLAYFAIR read a paper on the Astronomy of the Brahmins. [See Vol. II. No. XIII. *Phys. Cl.*]

Literary Clas. Dr DUNCAN read a Biographical Account of Sir WILLIAM DICK of Prestonfield, Bart. [See the Appendix to the History of the Society, Vol. II. p. 58.]

April 6.
Account of the
oldenlandia umbellata.

Phys. Cl. Dr ANDERSON read a communication from Dr JAMES ANDERSON of Madras, containing an Account of the *Oldenlandia Umbellata*, the Plant used for giving a red Dye to Cotton in the East Indies.

April 20.
Account of the
island and castle
of Lochurr.

Lit. Cl. Dr GREGORY read an Account of the Island and Castle of Lochurr, in the stewartry of Kirkudbright; communicated by Mr RIDDELL of Friars Carse, and transmitted by Lord HAILES.

ACCORDING to this account, Lochurr is situated in the midst of a wild country on the eastern border of Galloway, about ten miles east of the town of New Galloway. Upon the east side of the loch are two small islands, joined to the shore by a causeway of large stones, which is at present pretty deep under the surface of the water. The gentleman from whom Mr RIDDELL received this account, was obliged to wade along this causeway up to the middle, in order to reach the islands, and to proceed with a great deal of caution, as the water on each side was about 16 feet deep. The nearest and smallest of these islands he found to be covered with willows and long grass, and to be about 70 feet long by 36 broad. About 70 feet farther, is the largest of the islands, about 200 feet long and 72 broad, and surrounded by a wall of stones without mortar, six feet thick, and in some places five feet high.

On .

On each side of the entrance from the causeway, the wall is formed into a circular tower, and within it are three or four foundations of houses.

1789.

THIS little island is inhabited by adders, and by the large Scotch eagle, called the Earn.

ON leaving it, our traveller proceeded along the shore, about a mile toward the south, in order to visit another island, called the White Island. The White Island is in fact surrounded by the loch only on three sides. On the fourth, it is contiguous to a peat-moss of the kind called a flow-moss, and is separated from it by a ditch about 36 feet wide and 300 long, which ditch is strengthened by a strong breast-work on the side toward the island. You enter by what seems to have been the ancient gate, where the ditch is filled up. The island is about 552 feet long, and nearly of the same breadth. It appears to have been a Roman fortification, and in all probability is what CAMDEN calls the *Cardia of ANTONINUS*. There is a tradition here, that a number of Roman soldiers were starved to death in this island.

ON the east side of it, there are two mounts of about 38 feet in diameter each, and at some distance from one another. On the north side, the foundation of several buildings are still to be seen.

THE water of Urr runs out of the loch on the west side of this island.

IT is to be remarked, that the names of the places in this neighbourhood are Gaelic, which language was spoken in the remote parts of Galloway so late as 1671 and 1672.

Mr Professor DALZEL also read an Essay on Poetry, considered as an Imitative Art.

April 20.
Mr Dalzel on
poetry.

Lit. Cl. Dr ANDERSON read a paper, containing Observations on the Personal Pronouns.

June 15.
Dr Anderson on
personal pro-
nouns.

A

1789.

June 15.
Description of
a stone found at
Coilsfield.

A DESCRIPTION and Drawing of a Stone found at Coilsfield in Ayrshire, was communicated by Colonel MONTGOMERY of Coilsfield.

THE stone here referred to was found in digging a gravel-pit at Coilsfield, and under it an urn, of earthen ware, full of bones, not calcined, but broken down into small fragments, so that they resembled those found in the rock of Gibraltar. The stone is represented of an irregular figure, about five feet in length and two and a half in breadth. On the surface of it are traced, near one end, six concentric circles, at equal distances from one another; the diameter of the largest is about eighteen inches. The other lines traced on the stone are so very irregular, that no conjecture can be formed of what they were intended to express.

June 29.
General Meet-
ing.

A GENERAL Meeting of the Royal Society was held for the election of Members. [See Appendix to the History of the Society, Vol. II.]

July 3.
M. Monnet on
the formation on
minerals.

Phys. Cl. Dr WALKER read an Essay on the Formation of Minerals by M. MONNET.

July 20.
Dr Anderson
on the laws re-
specting debt-
ors.

Lit. Cl. Dr ANDERSON read a paper, entitled, Hints for the Improvement of the Laws in Scotland respecting Debtors.

Nov. 2.
Dr Guthrie on
the climate of
Russia.

Phys. Cl. An Essay on the Climate of Russia by Dr MATTHEW GUTHRIE of St Petersburg, was communicated. [See Vol. II. No. XV. *Phys. Cl.*]

Nov. 30.
General Meet-
ing.

A GENERAL Meeting of the Royal Society was held for the election of Office bearers. [See Appendix to the History of the Society, Vol. II.]

Phys.

Phys. Cl. Dr WALKER communicated some papers from Dr FRANCIS BUCHANAN of Leny. They contained observations on the Caves of Elephanta, a Description of two Water-spouts, and of a Luminous Appearance of the Sea.

1789.
Dec. 7.
On the caves of
Elephanta, &c.

Lit. Cl. A COMMUNICATION was read from Dr WILLIAM BLANE in India, being Observations on the Origin of the Numerical Characters, commonly called Arabic. The object of this paper was to prove, that these Characters are of Indian origin, agreeably to the opinion now generally received concerning them.

Mr HUME also read a Biographical Account of the late Sir THOMAS MILLER of Glenlee, Bart. [See Appendix to the History of the Society, Vol. II. p. 63.]

Dec. 21.
Dr Blane on
the Arabic cha-
racters.

Biographical
Account of Sir
Thomas Miller.

Phys. Cl. Dr HUTTON read a paper entitled, Observations on Granite. The paper is published in this volume. [No. II. *Phys. Cl.*]

1790.
Jan. 4.
Dr Hutton on
granite.

Sir JAMES HALL also read the first part of a paper, entitled, Observations on the Formation of Granite.

Sir James Hall
on granite.

Lit. Cl. Mr Professor DALZEL read a paper, containing Observations on the Pathetic in Poetry, and on the Union of the Pathetic and Sublime.

Jan. 18.
Mr Dalzel on
poetry.

A GENERAL Meeting was held for the Election of Members. [See Appendix to the History of the Society.]

Jan. 25.
General Meet-
ing.

Phys. Cl. JOHN CLERK, Esq; of Elden, read the first part of a paper, entitled, A Scheme for weighing up Ships sunk under Water.

Feb. 1.
Mr Clerk on
weighing up
ships.

Lit.

1790.

Feb. 15.

Mr Hunter on
the Latin com-
pound perfect
tense.

Lit. Cl. Mr DALZEL read a paper on the Latin compound perfect Tense, by Mr HUNTER, Professor of Humanity in the University of St Andrew's.

March 1.
Sir James Hall
on granite.

Phyf. Cl. Sir JAMES HALL communicated the remainder of his paper, *viz.* Observations on the Formation of Granite.

Sir JAMES HALL declined putting the two papers above mentioned into the hands of the Committee for publication, as they refer to Dr HUTTON's Theory, which the author has not yet explained so fully as he intends, but which he is preparing to give, accompanied by that variety of proofs and illustrations, which the profound reflection, and extensive observation of many years have furnished him with. The following abstract of them, therefore, is all that Sir JAMES thinks it proper to communicate at present.

THE first paper was suggested to him by a mineralogical excursion which he made in 1788, in company with the Honourable T. DOUGLAS, among the mountains of Galloway, in order to examine into the curious facts respecting the junction of the granite and the schistus, which were first observed by Dr HUTTON, as related in his paper mentioned above, and soon after communicated by him to Sir JAMES HALL. Sir JAMES accordingly having met with the line of separation of these two bodies, continued to follow it till he made the entire circuit of a considerable tract of granite country, which reaches from the banks of Loch Ken, where the junction is most distinctly seen, to the valley of Palnure, and occupies a mountainous space of about eleven miles by seven; and in all this extent, he found, that wherever the junction of the granite with the schistus was visible, veins of the former, from fifty yards, to the tenth of an inch in width, were to be seen running into the latter, and pervading it in all directions, so as to put it beyond all doubt, that the granite of these veins, and consequently of the great body itself, which he observed forming with the

veins one connected and uninterrupted mass, must have flowed in a soft or liquid state into its present position.

In giving an account of these observations, Sir JAMES HALL was led, by finding it impossible for him to express his ideas clearly on the subject, to enter at considerable length into a discussion of the terms of mineralogy, the imperfection of the language of that science, and the principles on which a less ambiguous nomenclature might be formed. He particularly pointed out, as the basis of such a nomenclature, the grand division which nature has made in the mineral kingdom, into stratified and unstratified bodies, the former comprehending both the primary and secondary strata, the latter comprehending granite, porphyry, basaltes, trap or whinstone, and lava.

He next stated the argument which the facts concerning granite that have been referred to above, afford in support of Dr HUTTON's Theory of the Earth. He remarked also the great number of facts which he had met with in Scotland, and in the volcanic countries of Italy, that were connected and explained by that theory, and by no other; concluding on the whole, that there was scarcely any system in physics established on more solid principles, and that the publication of it was likely to form a very important epoch in the history of this branch of philosophy.

To a theory, however, which embraces so great a variety of objects, some difficulties must be expected to occur; and this is the more likely to happen, that though the agents employed in it be such as we are well acquainted with, yet they are introduced as acting in circumstances very different from those in which we usually see them act.

Of these difficulties the most considerable appeared to Sir JAMES HALL to be the following: In granites which contain quartz and feld-spar, it frequently occurs, that the feld-spar is seen with the form of its crystals distinctly defined, whilst the quartz is a confused and irregular mass, being almost univer-

sally molded upon the crystals of felt-spar. Now, were it true, that all granite is formed by fusion, the very contrary, it would seem, ought always to take place, as felt-spar is very easily melted, and quartz resists the greatest efforts of heat that have hitherto been applied to it.

THIS difficulty is obviated thus: It is well known, that when quartz and felt-spar are pounded and mixed together, the mixture may, without difficulty, be melted and run into a kind of glass, the felt-spar serving as a flux to the quartz. The same fact may be stated in another way, by considering the felt-spar, when melted, as a fluid in which, as in a menstruum, the quartz is dissolved; and in this view, we may expect, by analogy, that phenomena, similar to those of the solution of salt in water, should take place. Now, it is certain, that when excessive cold is applied to salt water, the water is frozen to the exclusion of the salt, the ice obtained yielding fresh water when melted, and the salt, when the experiment is pushed to the utmost, separating from it in the form of sand. Why should not the same thing happen in the solution of quartz in liquid felt-spar, when the mass is allowed to cool below the point of congelation of the menstruum? The felt-spar may crystallize separately from the quartz, as we have seen pure ice formed separately from the salt; in both cases, the *congelation of the solvent* being *simultaneous* to that of the dissolved substance. Hence the crystals may mutually interfere with each other's forms, and we may as naturally expect to see quartz molded on crystals of felt-spar as the reverse.

IN answer to an objection which might be urged against this reasoning, *viz.* that the result of the fusion of granite is a glass in which no crystallization can be seen, an accidental experiment was produced, which had happened at one of the Leith Glass-houses a few weeks previous to the reading of this paper. A quantity of common green glass having been allowed, in a great mass, to cool gradually and very slowly, it was found to have lost all the properties

HISTORY of the SOCIETY.

11

ties of glass, being opaque, white, very hard and refractory, and wholly composed of a set of crystals, which shot into some cavities in a determined form. When a piece of this substance was melted by the violent heat of a blowpipe, and was allowed to cool instantly, it recovered all the properties of glass. We may conclude from this example, that if the glass produced by the fusion of granite had been allowed to cool with sufficient slowness, it might have crystalized, producing a granite similar to that which was originally melted.

THE same principle seems to point out the theory of all kinds of granite, and shows their connection with one another, and with all the other unstratified bodies. If quartz, feld-spar, schorl, mica, garnet, &c. happen to be melted together, the most fusible substance of them all may be considered as the menstruum in which all the rest are dissolved, and we may suppose, that these various dissolved substances may differ amongst themselves in their properties of solution, as salts differ from one another; so that some of them may be more soluble in the menstruum when very much heated, than when it is comparatively cold, and others may be as soluble in it, when little warmer than its point of congelation, as when raised to a much higher temperature. If then we say, for example, that the congealing point of the solvent is 1000 degrees of FAHRENHEIT, and if the solution is at the temperature of 2000, we may conceive one portion of the matters dissolved, as held by the simple dissolving power of the menstruum, and another portion as held by means of its elevated temperature. When therefore a mass of this kind is allowed to cool very slowly, as we may suppose must be the case with liquid granite in the bowels of the earth, those substances, held in solution by the heat of the solvent, will first separate, and being formed in a liquid, will assume their crystalline forms with perfect regularity; whereas those substances which were held by the menstruum simply as a fluid, will not separate till the congelation of the solvent itself

(B 2)

takes

takes place, when the crystals of the various substances will intermix and confound the regularity of form which each would have assumed if left to itself. In this manner, one of the most common kinds of granite will be produced, consisting of perfect crystals of schorl, mica or garnet, inclosed in a confused mass of feld-spar, quartz and schorl.

If the first stage of cooling is performed in the bowels of the earth, and if the solution, while still liquid, is by some effort forced upwards, and erupted into the open air in the form of a lava, which being spread thin upon the surface, and exposed to the air, would lose its heat suddenly, the crystals of schorl and of mica, originally held by the heat of the menstruum, will be of a large size, having been produced in the liquid when in a great mass, and when its heat of course escaped very slowly, there will be embodied in a mass formed of very small crystals, since they have been formed with great rapidity. This in fact is the description of one of the most common lavas, which consists of large and perfect crystals of schorl, embodied in a mass whose fracture is dull and rough, and which, when examined with a microscope, is found to consist of a congeries of minute crystals.

Thus, all the varieties among unstratified substances may be accounted for by the different circumstances in which each of them passed from a liquid to a solid state.

1790.
March 1.
Mr Clerk on
weighing up
ships.

Mr CLERK read the second part of his Scheme for weighing up Ships sunk under Water. [Vide supra, Feb. 1.]

Mr CLERK not having finished the drawings necessary for the illustration of this paper, did not put it into the hands of the Committee for publication; which, however, he has undertaken to do, before another volume of these Transactions can appear.

Lit.

Lit. Cl. Dr ANDERSON read a paper, entitled, Conjectures on the original Uses of those circular Buildings called *Dunes* in the northern part of Scotland.

1790.
March 15.
Dr Anderson
on dunes.

Phys. Cl. Dr RUTHERFORD read a Description of an Improvement made in the construction of the Thermometer, by JOHN RUTHERFORD, M. D. [See No. XII. of this volume, *Phys. Cl.*.]

April 5.
Dr Rutherford's
improvement of
the thermome-
ter.

Lit. Cl. Dr ANDERSON read an abstract of his paper on *Dunes*.

June 21.
Dr Anderson on
dunes.

A GENERAL Meeting was held for the election of Members. [See the Appendix to the History of the Society.]

June 28.
General Meet-
ing.

Phys. Cl. Mr KERR read a Description of an Animal *Ignotum* in the Museum of the University of Edinburgh.

July 5.
Mr Kerr on an
animal *ignotum*.

Phys. Cl. Dr HUTTON read Observations on the Theory of Rain, being an addition to the papers on that subject in the first volume of the Transactions of this Society, No. II. *Phys. Cl.* These observations are since published by Dr HUTTON in a separate work, *viz. Dissertations on different Subjects in Natural Philosophy*, Edin. 1792, and are contained in the third dissertation of the first part.

Aug. 2.
Dr Hutton on
the theory of
rain.

AT this meeting, there was also read an Account of Prince of Wales Island, given by Mr JAMES HOWISON, one of the surgeons of the new settlement in that island, communicated by Sir JOHN DALRYMPLE.

Mr Howison's
account of
Prince of Wales
island.

THE following are some of the most remarkable particulars contained in this account.

THIS island, which is described in the charts under the name of *Pulo Penany*, is situated in the entrance of the Straits of Malacca, in 100 degrees of east longitude and in 5 degrees of north latitude. It is about seven leagues in length and three in breadth.

breadth. Its northern extremity runs nearly parallel with the main land, at a distance of about two miles, by which a fine channel is formed, where the greatest fleets might ride in perfect safety, the height of the surrounding mountains acting as a barrier against the force of the prevailing winds.

THE climate of this island, considering its vicinity to the equator, is remarkably mild. Eighty degrees is about the mean height of the thermometer at noon, which, during the night, is seldom above seventy.

ITS healthfulness is certainly not surpassed by that of any European settlement on the coast. Out of a garrison of three hundred troops, (natives of Hindostan), not one has died for these last fourteen months ; a singular fact to be experienced by a new settlement in an uncleared country. This great salubrity is perhaps the effect of a constant ventilation, supported by almost continued but gentle breezes, added to the dryness of the soil, the uniform but gradual elevation from the sea to the foot of the hills preventing those stagnations of water which, in tropical latitudes, are so highly prejudicial to the health of man.

A RIDGE of beautiful mountains, deeply indented with valleys, and covered with evergreens, divides the island longitudinally. Innumerable rivulets receive their origin from these mountains, and are remarkable for the transparency and coolness of their waters.

THE soil, which is light and sandy near the sea, gradually changes to a rich clay as it approaches to the high lands. There the sugar-cane grows with the utmost luxuriance, and the most plentiful crops of rice are every where produced. Our gardens have already furnished us with cabbages and potatoes ; and when our industry shall have reached the tops of the mountains, it will be no surprise to see in our plantations most of the productions of Europe in their utmost perfection.

IN decorating the landscapes of this little island, nature has been peculiarly lavish. An assemblage of flowering trees and shrubs in perpetual blossom, and endless in the variety of their species, form the first shade. These are overtopped by forest trees of an immense height, which spread their vast branches on every side, and are covered with the richest foliage. Here strangers feel with rapture the effect of the breezes, which, from whatsoever quarter they blow, are strongly impregnated with the fragrance of the groves.

THE original animal productions of this island are very limited. Of quadrupeds, the wild hog, deer and squirrel, nearly comprehend the whole; but the absence of the tiger and leopard, whose numbers and ferocity almost render the opposite shores uninhabitable, amply compensates for this deficiency.

THE flying fox and squirrel are natives of this island; the former a non-descript, and a great natural curiosity.

Of birds we have also but few, and only one which is remarkable for the melody of its notes.

THE crow and sparrow, the never-failing attendants on population, have but lately made their appearance. They are now, however, rapidly increasing and multiplying. All the domestic animals arrive here at great perfection.

THE sea which surrounds us, affords a vast variety of fish of the most delicious flavour, and its shores abundance of the finest turtle and oysters. In no situation indeed are the conveniences and luxuries of life enjoyed in greater profusion.

THE advantages of the island in a political and commercial view, are too obvious to require to be pointed out.

Phys. Cl. Dr DUNCAN read a printed paper, being a communication from Dr JAMES JOHNSTON of Worcester, entitled, *Thoughts on the Functions and Diseases of the Lymphatic Glands.*

1790.
Nov. 1.
Dr Johnston on
the lymphatic
glands.

Lit.

1790.

Nov. 15.
Dr Doig on the
ancient Helle-
nes.

Lit. Cl. Mr DALZEL read the first part of a Dissertation concerning the ancient *Hellenes*, by DAVID DOIG, LL. D. Master of the Grammar-school of Stirling.

Dec. 6.

Dr Hutton on
the theory of
rain.

Phys. Cl. Dr HUTTON read farther Observations on the Theory of Rain. [See his Dissertations above referred to, Dissertation III. Part I.]

Dr WALKER also communicated an Account of a Bituminous Lake in the island of Trinidad, by Mr WILLIAM LOCHHEAD, Surgeon in Dominica.

Dec. 23.

Mr Frazer Tyt-
ler on transla-
tion.

Lit. Cl. Mr ERASER TYTLER read the first part of an Essay on the Principles of Translation.

1791.

Jan. 3.
Method of cul-
tivating the *ol-
denlandia um-
bellata*.

Phys. Cl. An Account of the method of cultivating the *Oldenlandia Umbellata*, or *Che Plant*, translated from the *Talinga* language by Dr ANDERSON of Madras, was communicated to the Society.

THE first thing to be attended to is the gathering of the seeds. When the plants are well grown and red-coloured, and after they have flowered and produced fruit and long roots, then it is time to get the seed. As the seeds are very small, and drop down under the plant, they can only be gathered with the sand, which must be kept in a heap till next year, as it cannot be used that year. The ground on which the seed is to be sown, should be sandy, supplied with sweet water, and well manured with sheeps dung. It is then to be plowed, the more frequently the better, perhaps seven or eight times. It must be perfectly level and clean, and divided into beds of one yard broad, and four yards long, with a narrow water-course between. The seeds must be sown thinly in these beds, and palmira leaves spread over the surface, and the water poured on them to prevent the seeds from being washed out of the earth, until they shoot up, which will be in five or six days. For two

months after this, the ground must be kept constantly wet, and sprinkled besides with water, having cow-dung mixed with it, every morning, to prevent the shoots from being blown off by the wind. During the remaining months, the cow-dung may be omitted, and the ground only watered twice a-day, morning and evening. Grass must not be allowed to grow. If managed as above, the plants will be perfect in six months, when they must be dug up with a long iron bar, to prevent the roots being broken, and bound up in small bundles, that are to be dried and bound into larger bundles, of two maunds, or 150 pound weight.

AFTER cutting or beating off the upper part, the roots must be well powdered, and mixed with four times their quantity of water in a pot, and boiled for some time, to prepare them for painting and dying red. For the painted calengary or chintz, the painters use other stuffs, together with Ché root, according to their convenience, as Brazil wood, to show them where the red is to be put; but the Ché root is the principal.

THE ground that is once planted with Ché root cannot be used again for the same purpose for six years.

AT this meeting, there was also read the first part of a paper, entitled, *Experiments and Observations on the Unequal Refrangibility of Light*, by Dr ROBERT BLAIR, Regius Professor of Astronomy in the University of Edinburgh.

Lit. Cl. Mr FRASER TYTLER read the second part of his *Essay on the Principles of Translation*. This essay has been since published separately.

A GENERAL Meeting of the Society was held for the Election of Members. [See Appendix to the History of the Society.]

1791.
Jan. 3.
Dr Blair on the
unequal refrangibility of light.

Jan. 17.
Mr Fraser Tytler on translation.

Jan. 24.
General Meet-
ing.

1791.

Feb. 7.

Dr Hutton on
periodical
winds, &c.

Phys. Cl. Dr HUTTON read two papers; the first contained Observations on the Periodical Winds which prevail in Britain during the spring and autumn; the second, An Essay on the Flexibility of the Brasilian Stone. The first of these papers is published in the work referred to above, viz. *Dissertations, &c.* by Dr JAMES HUTTON, and is the fourth Dissertation of the first part. The second is published in this volume. [*Phys. Cl.* No. III.]

Feb. 21.

M. Chevalier's
Tableau, &c.

Lit. Cl. M. CHEVALIER, of the Academies of Metz, Cassel, and Rome, read the first part of a paper, entitled, *Tableau de la Plaine de Troye*, accompanied with Maps.

Feb. 28.

M. Chevalier's
Tableau, &c.

Lit. Cl. At an extraordinary Meeting of the Society, M. CHEVALIER read the second part of his paper above mentioned.

March 7.

Dr Hutton on
phlogiston.

Phys. Cl. Dr HUTTON read the last of a series of papers on Phlogiston, of which the rest had been formerly communicated to the Society, and which are all published in the second part of the Doctor's *Dissertations* above quoted.

March 21.

M. Chevalier's
Tableau, &c.

Lit. Cl. M. CHEVALIER read the sequel of his paper, viz. *Tableau de la Plaine de Troye*. The paper is published in this volume. [*Lit. Cl.* No. I*.]

Biographical
account of Sir
James Hunter
Blair.

At this Meeting, MR GREENFIELD also read a Biographical Account of the late Sir JAMES HUNTER BLAIR, Bart. [See Appendix to the History of the Society in this volume.]

* N. B. By authority of the Committee of publication, and at the desire of the Author, this paper has been translated into English, and accompanied with large Notes, by MR DALZEL, Professor of Greek in the University of Edinburgh, and published separately in 4to: Which Translation and Notes have been, by permission of the Committee, translated into German, under the inspection of M. HEYNE of Gottingen; with a Preface, additional Notes, and a Dissertation, written by M. HEYNE himself, and published at Leipzic in 8vo.

Phyf. Cl. The sequel of Dr BLAIR's paper was read, viz. Experiments and Observations on the Unequal Refrangibility of Light. The paper is published in this volume. [No. I. *Phyf. Cl.*]

1791.
April 4.
Dr Blair on the unequal refrangibility of light.

Lit. Cl. The remainder of Dr DOIG's Dissertation on the ancient Hellenes was read.

April 18.
Dr Doig on the ancient Hellenes.

A GENERAL Meeting of the Royal Society was held for the election of Members. [See Appendix to the History of the Society.]

June 27.
General Meeting.

Phyf. Cl. There was read an Analysis of the Waters of the Hot Springs of Geyzer and Rykum in Iceland, by DR BLACK, Professor of Chemistry in the University of Edinburgh. The paper is published in this volume. [No. IV. *Phyf. Cl.*]

July 4.
Dr Black's analysis of the waters of Geyzer and Rykum.

Lit. Cl. Mr DALZEL read an Account of a Journey made from Rome to Tivoli, by ANDREW LUMISDEN, Esq; with a Description of a Marriage-ceremony, taken from a bas-relief on a sarcophagus at Tivoli, being a letter from the Author, addressed to JOHN MACGOWAN, Esq; Edinburgh. This paper, as being intended by Mr LUMISDEN for a part of a larger work, was not put into the hands of the Committee for publication.

July 18.
Mr Lumisden's journey to Tivoli.

Phyf. Cl. Dr HUTTON communicated some additional Observations on Granite. These make part of the paper referred to above. [No. II. of this volume, *Phyf. Cl.*]

Aug. 1.
Dr Hutton on granite.

Phyf. Cl. A Letter was read from JOHN THOMAS STANLEY, Esq; M. P. to Dr BLACK, giving an Account of the Hot Springs of Rykum in Iceland. This letter is published in this volume. [No. V. *Phyf. Cl.*]

Nov. 7.
Mr Stanley's account of the hot springs of Rykum.

1791.

SOME papers were also communicated at this meeting, from Mr LINDSAY, Surgeon in Jamaica.

Nov. 21.
Dr Ogilvy on
the theology of
Plato.

Lit. Cl. There was read the first part of an Essay on the Theology of PLATO, by the Reverend Dr OGILVY of Midmar in Aberdeenshire.

Nov. 28.
General Meet-
ing.

A GENERAL Meeting of the Royal Society was held for the election of Office-bearers. [Vide Appendix to the History of the Society in this volume.]

Dec. 19.
Dr Ogilvy on
the theology of
Plato.

Lit. Cl. A second part of Dr OGILVY's Essay mentioned above was read.

1792.
Jan. 2.
Account of a
variety of the
bramble.

Phyf. Cl. An Account was read of a variety of the Bramble found on the banks of Lochness in Inverness-shire, in a letter to Sir JAMES HALL from WILLIAM HALL, Esq; of Whitehall.

"Whitehall, shire of Berwick, Dec. 1. 1791.

"WHEN I was in the Highlands in the year 1787, I found "on the banks of Lochness a plant which had some resemblance to the common bramble, yet seemed to differ considerably from it in its habit or manner of growth. As the inhabitants said it bore a sweeter berry than the bramble, I procured some roots of it, and since that time have cultivated them in my garden here. I have observed it to possess the following characters.

"IT is of the genus *Rubus* of LINNÆUS. Though it appears to be akin both to the rasp (*Rubus Idæus*) and to the bramble, (*Rubus Fruticosus*), it differs in some respects from both. One or more erect stalks, with a very few short "prickles,

" prickles, shoot up from each root, and bear no fructification
 " the first year. In their second year, they begin to produce
 " flowers about the same time with the rasp-berry, in the first week
 " of June, three or four weeks before the bramble; but the fruit
 " does not come to maturity till the intermediate time between
 " ripening of the rasp-berry and bramble-berry, that is, about
 " the beginning of September. The fruit, which is of the colour
 " of the red mulberry, has a peculiar taste, somewhat different
 " from both. After bearing fruit, the stalk perishes in the second
 " year, like that of the rasp; but the root continues to produce
 " new shoots yearly, like that plant. Its characters may be ex-
 " pressed, in the Linnæan style, as follows:

" *Rubus (Neffensis) foliis quinato-digitatis, ternatis, septenisque*
 " *nudis, caule subinermi, petiolis canaliculatis; stolonibus erectis bi-*
 " *ennalibus.*

" As it is so nearly akin both to the rasp and the bramble,
 " it may perhaps be only a variety of one or the other. But as
 " it is to be met with in different places on the banks and among
 " the woods of Lochness, where it could not come from the
 " same root, it must have been propagated by the seed, and
 " would therefore seem to be a different species from either, and
 " from any other *Rubus* that I know of. I am," &c.

AT this meeting, was also read the first part of a paper on Electricity, by Mr JOHN LESLIE.

1792.
Jan. 2.
Mr Leslie on
electricity.

Lit. Cl. A part of Dr OGILVY's paper on the Theology of PLATO was read in continuation. The Society observed with regret, that the discussions of a religious nature contained in this learned communication, rendered an admission of it among their papers inconsistent with the nature of their plan; and therefore it was not put into the hands of the Committee for publication.

Jan. 16.
Dr Ogilvy on
the theology of
Plato.

1792.
Jan. 23.
General Meet-
ing.

March 5.
Mr Leslie on
electricity.

April 2.
Mr Playfair on
porisms.

June 4.
Dr Butter on
the cure of St
Vitus's dance.

June 25.
General Meet-
ing.

July 2.
Mr Taite's de-
scription of
mosses in Perth-
shire.

Nov. 5.
Dr Monro's de-
scription of a
male monster.

Nov. 26.
General Meet-
ing.

Dec. 17.
Biographical
Account of Dr
Drysdale.

A GENERAL Meeting of the Royal Society was held for the election of Members. [See the Appendix to the History.]

Phys. Cl. The remainder of Mr LESLIE's paper on Electricity was read. [*Vide supra*, Jan. 2.]

Phys. Cl. A paper was read on the Origin and Investigation of Porisms, by Mr PLAYFAIR. The first part only of the paper was communicated, and it is published in this volume. [*Phys. Cl.* No. VII.]

Phys. Cl. An Account was read of an Application of Hemlock to the Cure of St Vitus's Dance, by Dr BUTTER of London.

A GENERAL Meeting of the Society was held for the election of Members. [See the Appendix to the History.]

Phys. Cl. A paper was read, containing a Description of the Mosses of Kincardine and Flanders in Perthshire, by the Reverend Mr CHRISTOPHER TAITE, Minister at Kincardine. The paper is published in this volume. [No. III. *Lit. Cl.*]

Phys. Cl. Dr MONRO read a Description of a Human Male Monster, which is published in this volume. [No. IX. *Phys. Cl.*]

A GENERAL Meeting of the Society was held for the election of Office-bearers. [See the Appendix to the History.]

Lit. Cl. Mr DALZEL read a Biographical Account of the late Reverend Dr DRYSDALE. [See the Appendix to the History of the Society.]

A P P E N D I X.

LIST of MEMBERS or FELLOWS of the ROYAL SOCIETY of EDINBURGH, continued from the second Volume. [History of the Society, Appendix.]

THE following Members were elected at the General Meeting,
Jan. 25. 1790.

Members cho-
sen, Jan. 25.
1790.

RESIDENT.

Francis Garden, Esq; of Gardenston, one of the Senators of the College of Justice. L.

William Farquharson, M. D. Edinburgh. P.

William Tait, Esq; Advocate. L.

NON-RESIDENT.

Sir William Jones, Bart. President of the Asiatic Society, Calcutta. L.

Joseph Ewart, Esq; Minister Plenipotentiary of his Britannic Majesty at Berlin. L.

Hugh Clegborn, Esq; Professor of Civil History in the University of St Andrew's. L.

FOREIGN.

John Benjamin Jacobman, M. D. Koningsberg. P.

Christopher Girtanner, M. D. of St Gall, Switzerland; corresponding Member of the R. S. at Gottingen. P.

Count Reden, Director of the Mines in Silegia. P.

M. de la Grange, of the Royal Academy of Sciences at Paris. P.

HONO-

HONORARY.

Baron Hertzberg, Berlin.

Members chosen, June 28.
1790.

THE following were elected at the General Meeting, June 28.

1790.

RESIDENT.

Norman Macleod, Esq; of Macleod. L.

NON-RESIDENT.

Francis Kinloch, Esq; of Gilmerton. P.

Members chosen, Jan. 4.
1791.

THE following were elected at the General Meeting, Jan. 4.

1791.

RESIDENT.

John Burnet, Esq; Advocate. L.

NON-RESIDENT.

Charles Scott, M. D. London. P.

James Clerk, M. D. Dominica. P.

Mr William Lochead, Surgeon, Antigua. P.

Mr Alexander Anderson, Intendant of the Royal Botanical Garden, St Vincent's. P.

William Roxborough, M. D. Madras. P.

FOREIGN.

M. Chevalier, of the Academies of Metz, Cassel and Rome. L.

THE following were elected at the General Meeting, June 27.
1791.

Members cho-
sen, June 27.
1791.

NON-RESIDENT.

Daniel Braithwaite, Esq; F. R. S. Lond. L.
Robert Townson, Esq; P.
James Anderson, M. D. Madras. P.
James Bell, D. D. Coldstream. L.

THE following were elected at the General Meeting, Jan. 23.
1792.

Members cho-
sen, Jan. 23.
1792.

RESIDENT.

William Hall, Esq; of Whitehall. P.
*Andrew Coventry, M. D. Professor of Agriculture in the Univer-
sity of Edinburgh. P.*
John Rotheram, M. D. P.

NON-RESIDENT.

Sir Joseph Banks, Bart. P. R. S. Lond. P.
William Saunders, M. D. London. P.
Maxwell Garthj bore, M. D. London. P.
John Stark Robertson, M. D. Bath. P.
Alexander Hunter, M. D. York. P.
Alexander Johnson, M. D. London. P.

FOREIGN.

*Dr Kemp, Professor of Mathematics in Columbia College, New
York. P.*

Members chosen, June 26.
1792.

THE following were elected at the General Meeting, June 26.
1792.

NON-RESIDENT.

Theophilus Houlbrooke, Esq; P.

George Robertson, Esq; in the service of the Honourable East India Company. P.

Members chosen, Jan. 27.
1793.

THE following were elected at the General Meeting, Jan. 27.
1793.

RESIDENT.

Alexander Muir Mackenzie, Esq; L.

NON-RESIDENT.

Richard Pulteney, M.D. Blanford, Dorsetshire, F. R. S. Lond. P.

Mr John Lindsay, Surgeon in Westmoreland, Jamaica. P.

Mr Mackay, of the Observatory, Aberdeen. P.

Thomas Wallace, Esq; of Carlton Hall, Cumberland. L.

FOREIGN.

Don Antonio Gimbernat, First Surgeon to the King of Spain, and Director of the Royal College of Surgery at Madrid. P.

Samuel Latbam Mitchill, M. D. Professor of Economics, Columbia College, New York. P.

Members chosen, June 24.
1793.

THE following were elected at the General Meeting, June 24.
1793.

NON-RESIDENT.

Thomas Newte, Esq; of London. P.

Thomas Somerville, D. D. at Jedburgh. L.

OFFICE.

OFFICE-BEARERS of the SOCIETY.

General office-
bearers.

OFFICE-BEARERS elected for the ensuing Year, at the General Meeting held for that purpose, Nov. 29. 1790.

President.

His Grace the Duke of BUCCLEUGH.

Vice-Presidents.

Lord Dunfountain.

Right Hon. Henry Dundas.

Secretary.

Treasurer.

Professor John Robison.

Mr Alexander Keith.

Counsellors.

Mr Benjamin Bell.

Professor Ferguson.

Mr Greenfield.

General Fletcher Campbell.

Mr George Fergusson.

Mr Mackenzie.

Dr Gregory.

Lord Dregborn.

Dr Rutherford.

Commissioner Edgar.

Professor Stewart.

Lord Elliock.

Office-bearers
of the classes.

OFFICE-BEARERS of the two CLASSES.

PHYSICAL CLASS.

Presidents.

Dr Black.	Dr Home.
Dr Hutton.	Dr Monro.

Secretaries.

Professor Playfair.	Dr Walker.
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LITERARY CLASS.

Presidents.

Mr Baron Gordon.	Principal Robertson.
Sir William Miller.	Dr Hugh Blair.

Secretaries.

Mr Fraser Tytler.	Professor Dalzel.
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At the General Meetings in 1791 and 1792, the same office-bearers were re-elected.

List

LIST OF MEMBERS deceased, continued from the second volume.

Members de-
ceased.

William Cullen, M. D. Professor of the Practice of Physic in the University of Edinburgh, &c. Feb. 5. 1790.

William Hamilton, M. D. Professor of Anatomy and Botany in the University of Glasgow. March 13. 1790.

David Stuart Moncreiff, Esq; one of the Barons of Exchequer. April 17. 1790.

John Leslie, M. A. Professor of Greek, King's College, Aberdeen. May 24. 1790.

Major General William Roy, F. R. S. Lond. May 30. 1790.

Alexander Millar, Esq; Advocate. June 30. 1790.

Henry Cullen, M. D. one of the Physicians of the Royal Infirmary, Edinburgh. Oct. 11. 1790.

Robert Henry, D. D. one of the Ministers of Edinburgh. Nov. 24. 1790.

David Erskine, Esq; Writer to the Signet. April 5. 1791.

John Steedman, M. D. April 16. 1791.

James Gillespie, D. D. Principal of St Mary's College, St Andrew's. June 2. 1791.

Alexander Stevenson, M. D. Professor of Medicine in the University of Glasgow. June 4. 1791.

Adam Smith, Esq; LL. D. Commissioner of his Majesty's Customs, &c. July 17. 1791.

The Reverend Mr Matthew Murray, Minister of North Berwick. August 13. 1791.

Joseph Ewart, Esq; his Majesty's Minister Plenipotentiary at Berlin. Jan. 27. 1792.

Robert Adam, Esq; Architect, F. R. S. Lond. March 3. 1792.

The Right Hon. John Earl of Bute, &c. March 10. 1792.

William Tytler, Esq; of Woodhouselee, Writer to the Signet. Sept. 12. 1792.

John Russell junior, Esq; Writer to the Signet. Dec. 2. 1792.

Colonel Andrew Fraser, of the Engineers. 1792.

William Chalmers, M. D. Professor of Medicine, King's College, Aberdeen. Dec. 14. 1792.

William Robertson, D. D. Principal of the University of Edinburgh, &c. June 11. 1793.

George Stuart, LL. D. Emeritus Professor of Humanity in the University of Edinburgh. June 18. 1793.

William Morehead, Esq; of Herbertshire. June 19. 1793.

FOREIGN MEMBERS deceased.

Benjamin Franklin, Esq; LL. D. April 17. 1790.

M. le Clerc de Sept Chênes, Paris. 1791.

SINCE the publication of the second volume, the following BIOGRAPHICAL ACCOUNTS have been read at different Meetings of the Classes *.

L Ac-

* N. B. The Publication of the Biographical Account of the late Dr ALEXANDER WILSON, Professor of Practical Astronomy in the University of Glasgow, is delayed at the request of his son; as some papers have been mislaid, which he hopes may still be recovered, and which will render the Account in a future volume more complete. [See History of the Society, p. 3. in this volume.]

I. ACCOUNT of Sir JAMES HUNTER BLAIR, Bart.

[*Read by Mr GREENFIELD, March 21. 1791.*]

THE following account of a late respectable Member will not, I am persuaded, be unacceptable to the Society. He was one of the twenty-two who obtained the charter of its incorporation; and although his situation did not permit him to aim at literary distinction, he is entitled to an honourable place in its records, both from the worth of his private character, and also from his eminent activity and usefulness in public life.

Sir JAMES HUNTER BLAIR was the second son of Mr JOHN HUNTER, merchant in Ayr, and was born in that town on the 21st day of February 1741. His father acquired a considerable property in land and money, and left his children, who were still young at his death, in easy circumstances.

IN the year 1756, Sir JAMES was placed as an apprentice in the house of COUTTS, BROTHERS and Company, Bankers in Edinburgh. It was at this time that his friendship commenced with Sir WILLIAM FORBES, who had entered into the same situation about two years before, and who was afterwards his partner in business. Sir WILLIAM, in a very interesting letter, written after Sir JAMES's death, expresses himself thus: "Our friendship terminated only with his life, after an intimacy which few brothers can boast of, during thirty-one years; in which long period, we never had a difference, nor a separation of interest."

AFTER

Account of Sir
James Hunter
Blair.

AFTER the death of Mr JOHN COUTTS, the principal partner of the House, Sir WILLIAM and Sir JAMES were admitted to a share of the business in 1763, and gradually rose to the head of the copartnery.

IT was also in 1763 that Sir JAMES first became a member of the Town-council of Edinburgh, during the administration of Provost DRUMMOND, whose memory will long be respected by the inhabitants of this city. He afterwards continued occasionally to have a seat in the Council, and filled all the different offices of Magistracy.

IN December 1770, he married Miss JANE BLAIR, eldest daughter of JOHN BLAIR, Esq; of Dunlekey in the county of Wigton. It is remarkable, that this lady's father, at his death, left no fewer than six sons, four of whom were alive at the time of their sister's marriage, but all of them having died, she succeeded in 1777 to the family-estate. Sir JAMES on this occasion, received the name of BLAIR, and was afterwards, in the year 1786, created a Baronet of Great Britain.

ON the estate which had thus unexpectedly devolved to him, he commenced a plan of most extensive and judicious improvement. He nearly rebuilt the town of Portpatrick ; he repaired and greatly improved the harbour ; he established packet-boats of a larger size on the much frequented passage to Donaghadee in Ireland ; and, lastly, while the farmers in that part of Scotland were extremely ignorant of their business, he set before them a successful example of the best modes of agriculture, the greatest service perhaps which can be performed by a private man to his country.

IN September 1781, upon the death of the Member at the time, he was called, without any solicitation upon his part, to represent the city of Edinburgh in Parliament ; and at the general election in summer 1784, he also received the same honour of an unsolicited and unanimous nomination ; an event almost singular at that period of violent political struggle. But before

the

the end of the first session, he resigned his seat, as he found the attention required by his business inconsistent with his attendance in Parliament, and he did not chuse to retain a place when he could not discharge the duties of it properly.

Account of
Sir James Hun-
ter Blair.

AT Michaelmas 1784, in compliance with the urgent request of the Town-Council, he was elected Lord Provost of Edinburgh ; and in this situation, he exerted, in a very conspicuous manner, the indefatigable activity of his public spirit. For it was he who set on foot those great operations which are at present carrying on for the improvement of the city, and of which one of the most important objects was the rebuilding of the College.

THE first step of these operations was a work of great utility and magnificence. The access to Edinburgh from the south, on account of the narrowness and steepness of the lanes, was not only very incommodious, but even hazardous ; and accordingly, it had often been proposed to open a communication between the High Street and the southern parts of the city and suburbs, by means of a bridge over the Cowgate. But the scheme, although its great importance was abundantly obvious, appeared so expensive, and was attended with so many other difficulties, that every former attempt had proved unsuccessful, and it required all the ardour and influence of Sir JAMES HUNTER BLAIR to carry it into execution.

WE owe the accomplishment of it, however, not merely to his ardour and influence, but also to his sagacity. For in order to defray the great expence, he devised means, which, to men of less discernment or knowledge in business, appeared very inadequate to the purpose. His scheme was this : The property which lay in the line of the intended communication, and to a considerable distance on each side of that line, was to be purchased at its real value at the time ; and after the communication was opened, such parts of the ground thus purchased as

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(E)

were

Account of
Sir James Hun-
ter Blair.

were not to be left vacant, were to be sold again for the purpose of erecting buildings according to a plan. Sir JAMES conceived, that the sale of these areas, in consequence of the great improvement of their situation, would raise money sufficient, not only to pay for the first purchase of the property, but also to defray the expence of building the bridge, and whatever else was necessary for completing the communication. But lest there should be any deficiency, and likewise to afford a security for borrowing the money which might be requisite, the trustees for carrying on the work were to be empowered to levy a sum not exceeding 10 *per cent.* of the valued rents of the houses in Edinburgh and the environs ; and in order to remove all just cause of complaint, he proposed, that if any of the owners of the property to be purchased should not agree with the trustees, the price of their property should be fixed by the verdict of a jury, the jury consisting of fifteen persons, who were chosen by lot out of forty-five proprietors of houses or land in the city or county, named by the Sheriff in each particular case.

THESE proposals were published in November 1784, and met with the same reception which has often attended schemes of still greater importance and more extensive utility. They were censured and opposed from various quarters, and sometimes even with virulence. A man of less ardour and public spirit would have yielded to the discouragements which Sir JAMES experienced on this occasion. Fortunately, he was of such a temper, that they served only to rouse his exertions, without rendering him less prudent in his measures. His perseverance surmounted every opposition. An act of Parliament was obtained for carrying into execution, not only the plan which has been mentioned, but likewise several others of great consequence to the place ; and on the 1st day of August 1785, the work was begun, by laying the foundation-stone of the bridge, which

which now connects, by an easy and spacious communication, the suburbs on the south with the rest of the city.

Account of
Sir James Hun-
ter Blair.

WITHIN little more than two years, (such was the activity of the managers), the bridge was completely finished ; and although the expence, including the first purchase of the property, amounted to not less than L. 63,000, yet it is expected, when the areas which still remain to be sold are disposed of, and the prices of those already sold are paid up, that the trustees for the bridge will be enabled to pay over to the Magistrates, for the purpose of carrying on the rest of the intended improvements, the whole or the greatest part of the 10 per cent. assessment.

Sir JAMES lived only to see the commencement of the great works which he had projected. In spring 1787, he went to Harrowgate for the recovery of his health, but without the appearance of any alarming complaint. The waters had not the success which was expected. In the month of June, his indisposition was much increased, and terminated in a fever. He died on the 1st day of July 1787, in the 47th year of his age. His remains were conveyed to Edinburgh, and deposited in the Gray-friars Church-yard. On this occasion, the Magistrates and Council, and the Principal and Professors of the University, attended in their gowns of office, to testify their respect for his character, and their sense of the importance of his services ; and the public in general lamented sincerely, that a man so active and zealous, and so much superior to narrow and selfish views, was not spared to complete what he had so happily begun.

IN private life, he was affable and cheerful, warmly attached to his friends, and anxious for their success. In business and in his public exertions, he was upright, liberal, disinterested and patriotic : And he possessed, in no common degree, those talents which are requisite for rendering benevolence effectual ;

Account of
Sir James Hun-
ter Blair.

for to an unwearied application, he united great knowledge of the world, sagacity in business, and a sound understanding. His virtues and labours were not unrewarded. His life was short indeed, but it was prosperous and happy ; he enjoyed a very great share of the public esteem ; in spite of the interests and prejudices which he combated, he had no personal enemies ; of the numbers whom he obliged, few were ungrateful ; he was beloved by his friends ; and no man perhaps was ever blessed with a greater portion of domestic felicity.

II. Ac-

II. ACCOUNT of JOHN DRYSDALE, D. D.

[*Read by Mr DALZEL, Dec. 17. 1792.*]

IF that found judgement, which discerns what is right and wrong, with uncommon acuteness and precision; that firm adherence to rectitude of conduct, which excites admiration, and commands respect; those generous and benevolent dispositions of heart, and that indefatigable attention and beneficence to friends, which produce the most ardent affection, gratitude, and attachment on the part of those friends; that argumentative, powerful, and animated eloquence, which comes from the heart, and irresistibly impresses on the minds of the hearers, the sublime truths of religion and morality; that ardour of mind, and those superior talents, which are restrained only by invincible diffidence and modesty, from informing and pleasing mankind by the production of various works of literary genius;—if a character possessed of such endowments and qualities as these, has any claim to be recorded among the monuments of men, the memory of the person who is the subject of the following narrative, ought not to be suffered to pass into oblivion.

Dr JOHN DRYSDALE was born at Kirkaldy, in the county of Fife, on the 29th day of April 1718; being the third son of the Reverend Mr JOHN DRYSDALE, Minister of Kirkaldy, and of ANNE FERGUSON, daughter of WILLIAM FERGUSON, Esq;

Provost,

*Account of
Dr Drysdale.*

Provost, or chief Magistrate, of the same town. He received the elements of classical learning at the parish school, under DAVID MILLER, a man who had also the honour of instructing the celebrated ADAM SMITH, and JAMES OSWALD of Dunikeir, persons who have reflected so much lustre on their country, the one as a philosopher and man of letters, and the other as an eminent statesman. Under the same master, were also educated Dr JOHN OSWALD, Bishop of Raphoe in Ireland, and Dr GEORGE KAY, one of the ministers of Edinburgh, men likewise of considerable talents, and accomplishments. So that MILLER had reason to boast, that few individual masters of the most opulent and celebrated schools, had sent from their tuition a greater number of eminent men, than had been sent by him from the obscure school of Kirkaldy.

WHILE at school, JOHN DRYSDALE greatly distinguished himself as a classical scholar; and there he contracted that strict friendship with the most eminent of his schoolfellows, particularly Mr OSWALD and Mr SMITH, which continued unimpaired through life. When he was thought to be sufficiently prepared for the University, to which young men go at a much earlier period in this country than in England, he was sent to College at Edinburgh in the year 1732. He there prosecuted his studies with great success, and soon attracted the notice of the Professors, by the rapid progress he made in the acquisition of knowledge. After passing through the ordinary courses of languages and philosophy, he engaged in the study of divinity, the ultimate object of his repairing to the University; and having prosecuted this the usual time, he was admitted to trials, according to the forms of the Church of Scotland, before the Presbytery of Kirkaldy; and by them licensed to preach the Gospel, in the year 1740.

HE was soon after employed as assistant to the Reverend Mr JAMES BANNATYNE, minister of the College Church, Edinburgh; and while he publicly officiated there, he was much

admired as an original, powerful, and rational preacher. His distinguished abilities, great integrity, goodness of heart, and agreeableness of manners, now procured him the friendship and confidence of several other persons, who afterwards became celebrated in the republic of letters; and, about this time, a particular incident occurred, which was an earnest of that generosity of mind, for which he was afterwards so remarkable. Mr OSWALD, who was now making a figure in public life, had remained his firm friend, and had promised to bestow on him the first living in the Church he should be able to procure. The parish of Kennoway, in Fife, became vacant, and at the disposal of Mr OSWALD; but Mr DRYSDALE having heard, that his friend was embarrassed by a certain political connection, which made it extremely eligible to bestow that living upon another candidate, he took an early opportunity of waiting on Mr OSWALD, and having voluntarily renounced his claim, he begged of his friend, by all means to yield to the political application in favour of his rival; for which Mr OSWALD ever after considered himself as under the greatest obligation to him. Indeed, at every period of his life, the conferring of a favour on a friend, was to Mr DRYSDALE a much more powerful motive of action, than the view of obtaining any personal emolument; and in examining the foundations of morality, a subject in which, as well as his friend Mr SMITH, he took great delight, and to which he had paid particular attention, the feelings of his own mind were sufficient to induce him to reject with disdain the system of those philosophers who deduce all human actions from a selfish source.

IN the year 1748, he obtained a Crown-presentation to the church of Kirkliston in West Lothian, by the interest of the late JOHN Earl of Hopetoun, to whom he had been recommended by WILLIAM ADAM, Esq; of Maryburgh, Architect, whose third daughter he afterwards married.

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IN entering upon this charge, he met with some slight opposition, owing to an opinion industriously propagated, that the style and method of his preaching were not sufficiently popular, and that his discourses contained too great a proportion of the doctrines of morality. But this objection was soon obviated, after the people of the parish became better acquainted with him ; among whom he had not remained long, till he became the object of a very general regard and esteem, not only by the kindness of his disposition and his unwearied beneficence, but from the interesting and animated method in which he inculcated the great truths of religion and morality in his sermons. Never were discourses better calculated to command the attention, and influence the conduct, than those which he preached to the crowded congregations that attended him.

THOUGH he had accustomed himself to compose and write sermons with great care, yet he seldom, especially in the earlier part of his life, used to carry his written discourses to the pulpit. His usual method of preaching was, after carefully studying the subject, to speak from the heads of discourse which he had marked down. Often, when he had entered upon the discussion of one of those heads, he grew so animated, and poured forth such a copious torrent of interesting illustration, that he found the time exhausted before he had finished one half of what he had intended to say. He was therefore obliged to defer the remainder of the subject to one or more subsequent discourses, which he continued with equal vivacity and force.

He possessed a most uncommon fertility of original thought ; and although his eloquence was chiefly argumentative and rational, yet it was sometimes pathetic, often sublime, often embellished with the richest ornaments of original fancy, always bold and manly, and always marked with the dignity and vigour of an upright mind. Hence he was extremely successful in exhibiting the grandest and most amiable pictures of virtue, and in exposing the meanness and deformity of vice in the

most odious and detestable colours. Whatever he uttered was natural, unaffected, and full of energy, always flowing from the heart, and always discovering a deep penetration into the human mind.

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IN entering upon his subject, he seemed at once to seize upon the most proper and rational views of it; and he carried his listening audience along with him, in a rapid and fervid train of just, pure and elevated sentiment, from the beginning to the end of his discourse. His sermons by no means consisted, as had been insinuated, of the mere doctrines of morality. These he certainly did most strenuously inculcate; but, at the same time, no man ever brought home to the minds of his hearers, with greater force and efficacy, the genuine spirit of that religion which he preached.

His mode of delivery, though by no means correct, was extremely animated and striking. His gesture was frequently vehement; and though not always graceful, because not studied, but produced by his real feelings, yet it had a most powerful effect. Nor were the elevations and depressions of his voice by any means consistent with those rules which professed teachers of the art of elocution inculcate. These too were entirely directed by his own sensations, and suited to his own original mode of speaking. But however irregular his tones and his emphasis might sometimes be, still what he uttered came always home to the hearts, and effectually commanded the attention, of every audience.

IN that part of the service of the Church of Scotland which consists of a portion of scripture read and explained from the pulpit, and which is called the Lecture, Mr DRYSDALE displayed uncommon ability and skill. He expounded the scriptures in a plain, simple and connected manner, so as to render the meaning quite intelligible to ordinary capacities. But wherever he found a passage that he either did not clearly understand himself, or despaired of making edifying to his hearers, he

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frankly avowed the difficulty, and told the audience, that instead of amusing them with a variety of conjectures, either of the commentators or of his own, he would pass on to something from which they would reap much more advantage. For he never lost sight of what he had conceived to be the great object of all religious instruction, practical improvement, not speculative opinion. The instructions and exhortations with which he accompanied the ordinances of religion, particularly the dispensing of the sacrament of the LORD's supper, all tended to the same end, namely, the amendment of the hearts and lives of his people ; and they were all delivered with such earnestness of manner, as convinced the hearers, that they came from a pure and benevolent mind, intent upon promoting their best interests.

As the service of the Church of Scotland does not admit of set forms of prayer, but leaves the minister to use his own expressions in addressing the Supreme Being, Mr DRYSDALE's talents were in nothing more conspicuous than in this essential part of public worship. He did not indeed assume any studied solemnity of manner ; but, with unaffected gravity and fervour, poured forth the genuine and copious dictates of his heart, in the most glowing, various and proper expressions ; and so far was he from repeating any particular studied form of words in his prayers, that his audience used to remark, that on hearing the beginning of his sentences, they seldom were able to anticipate the conclusion.

SUCH were his abilities as a minister of religion ; and with these the irresistible amiableness of his manners, and the known integrity of his private life, concurred to render him the object of the highest esteem and regard of his parishioners. Even the lowest of the people respected and revered his character ; and such was the success with which his instructions were attended, that it was observed of the morals of the inhabitants of the village in particular, which had been formerly noted for irregularity.

tity and vice, that they underwent a surprising change for the better, during the time of Mr DRYSDALE's ministry ;—a strong proof of the great utility of well-qualified teachers of pure and undefiled religion in any state !

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THUS he lived for fifteen years, discharging with fidelity the functions of a country clergyman, enjoying the domestic society of his own family, and the conversation of many literary and clerical friends who occasionally visited him.

AT length, in the year 1763, his sincere and steadfast friend Mr OSWALD found an opportunity of serving him, by prevailing with the late Earl of BUTE to use his influence with the Town-council of Edinburgh, that Mr DRYSDALE might be admitted one of the ministers of that city. GEORGE DRUMMOND, Esq; at that time Lord Provost of Edinburgh, exerted himself with great activity on that occasion. Though it was pretty well understood, that the right of presenting ministers to the city was vested in the Lord Provost, Magistrates and Council, yet a practice had prevailed for the Council to waive the exercise of that right, and to permit the general kirk-sessions of the city to be the electors of their own ministers. The Lord Provost thought proper, for good reasons, to deviate from that mode of election on this occasion ; and he prevailed with the Council to grant a presentation to Mr DRYSDALE to supply the vacant charge. This produced a considerable degree of opposition on the part of those who were desirous that the election of ministers should remain in the hands of the general sessions. But the Council were determined to maintain what they imagined to be their right ; and after a civil process, the question was decided in their favour. Several interlocutors had been passed in the Presbytery of Edinburgh hostile to the translation of the presentee, which caused the affair to be brought before the Synod of Lothian and Tweeddale, where they were all over-ruled,

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and the settlement ordered to proceed ;—a decision which was finally affirmed by the General Assembly.

No sooner did Mr DRYSDALE enter upon his new charge as minister of Lady Yester's, than all were convinced, that however disagreeable to some the mode of his introduction might be, no opposition was due to him as a man, and as a minister. The sermons which he preached in that church attracted always a great concourse of hearers, whom he never failed to delight and instruct by an eloquence of the most nervous and interesting kind. Both his train of thought, and his manner of expression, were evidently such as strongly indicated a vigorous understanding, an original genius, and a profound knowledge of the human heart.

His reputation as a preacher afterwards rose so high, that on occasion of an excursion which he made to London to visit his friends and relations there, the late Mr STRAHAN earnestly requested, that he would furnish him with a volume of sermons for publication. His friends pressed him much to embrace this proposal ; and he seemed at length disposed to comply with their wishes. For on his return to Scotland, he began to revise his sermons with a view to make a selection for publication ; but he had not proceeded far till his diffidence induced him to procrastinate, and at last to relinquish, every resolution of that sort.

THE same native diffidence and modesty were likewise the cause of his declining to appear as a speaker in the judicatories of the church. While he remained in the country, he seemed rather to avoid taking much concern in the management of church-affairs ; but on his coming to Edinburgh, he found himself so much connected with Dr ROBERTSON, to whom he was always greatly attached as a friend, and to whom he considered himself as under great obligations, particularly for the earnest and effectual manner in which he had espoused his interest

terest in his translation to town, that he resolved to give that eminent leader every assistance in his power in support of what was called *the moderate party* in the church; the chief object of whose policy was, to maintain the right of presentation as established by law, against those who considered that mode of settling ministers of the gospel as a great grievance, and who stood up for the superior justice of popular election. With respect to the merits of the question itself, men will always be found to differ, nor is it proper here to enter upon the discussion of it. But be it as it may, Mr DRYSDALE was fully persuaded of the rectitude of that side he had embraced; and though he did not speak in the church-courts, Dr ROBERTSON could not have been more fortunate in a co-adjutor. The native benevolence of his heart was conspicuous in his manners, which were extremely popular and engaging; and no sooner did he begin to extend his acquaintance with his brethren, than he wonderfully conciliated their esteem and affection. He took every opportunity of obliging them, both as individuals and as a body; and his influence among them soon became very extensive.

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WITHOUT any solicitation on his part, and even without his knowledge, the Marischal College of Aberdeen conferred on him the degree of Doctor in Divinity, by diploma, bearing date the 15th of April 1765: And the following year, the death of the Reverend Dr JOHN JARDINE having produced a vacancy in the Tron-church, which is collegiate, Dr DRYSDALE was translated thither from Lady Yester's, which is a single charge. He there had the good fortune to have for his colleague the Reverend Dr GEORGE WISHART, principal clerk to the Church, for whom he had long entertained the highest esteem and respect; and Dr WISHART, in his turn, having a most sincere affection for *bim*, they found the greatest comfort in being now so nearly connected. Never did two colleagues live together in more cordial and uninterrupted habits

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of friendship ; their constant study being to oblige each other by a perpetual series of mutual good offices.

By the death of Dr JARDINE likewise, Dr DRYSDALE now obtained a share in the few clerical offices which the Crown has to bestow on the clergy of Scotland. By Royal warrant, he was appointed one of his Majesty's chaplains, with one third of the emoluments of the Deanry of the Chapel Royal. The late Marquis of Rockingham was then Prime Minister ; and he was determined in his choice of Dr DRYSDALE solely by the recommendation of Dr ROBERTSON.

As this office much improved Dr DRYSDALE's pecuniary circumstances, it furnished him with the means of indulging his inclination for domestic hospitality to a much greater extent than he had hitherto done. His house was open at all times to his numerous friends and acquaintance, and it was their frequent place of resort. There, in particular, many of the younger clergy, and other young men, enjoyed the advantage of his agreeable conversation, and never were happier than when in his company. There was something so cheerful, so unassuming, so benign, and, at the same time, so upright and decided in his manner, that he gained the esteem and good will of all who had any connection with him, without ever exciting the least degree of envy. Even such as were of different sentiments in church-affairs esteemed the man ; and with several of these he maintained a very friendly intercourse. As his turn of thinking on all subjects was clear, acute and judicious, he was very expert in the method of conducting affairs. He had a peculiar facility and elegance of expression in the numerous letters he had occasion to write, in a most extensive correspondence which he carried on throughout the Church. No person who applied to him for a favour from the remotest parts of the kingdom ever found the application treated with neglect ; but, on the contrary, he was soon convinced, that Dr DRYSDALE had made every practicable exertion in his behalf. With such

such talents, and such dispositions, it is not to be wondered at that in a few years he should have had a very great influence in the Church ; and that the party with which he was connected, should have derived essential advantage from his steady activity, prudence and popularity.

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IN the year 1773, Dr DRYSDALE's numerous friends thought it due time to raise him to the dignity of Moderator of the General Assembly, the greatest mark of respect which an ecclesiastical commonwealth can bestow on any of its members ; and being accordingly chosen without opposition, he discharged the duties of the office with great satisfaction to the Venerable Court, and credit to himself.

AFTER this period, his influence among the ministers and elders of the Church still continued to increase, while he persevered in seizing every opportunity to do all the service in his power, either to the Church in general, or to its members as individuals. When his venerable colleague Dr WISHART began to feel the approaches of old age, and the discharge of the duty of clerk to the General Assembly was growing burdensome to him, Dr DRYSDALE was always at hand to assist and to relieve him ; till at last, during the Assembly 1778, Dr WISHART gave in a representation to the Court, expressing his desire to resign the clerkship, in order that he might be re-elected, in conjunction with another person, on whom he might, under the infirmities of age, devolve the laborious part of the duty. Next day, the Assembly having considered this proposal, accepted of Dr WISHART's resignation, and then unanimously re-elected him, in conjunction with Dr DRYSDALE, in the way in which he had desired.

IN the year 1784, it was apprehended, that the choice of a Moderator of the General Assembly might occasion a dispute betwixt the two great parties in the Church. After deliberation,

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tion, the leaders on the moderate side pitched upon Dr DRYSDALE as their candidate, thinking that of all others he was most likely to defeat the views of their antagonists. But they found great difficulty in prevailing on him to comply with their wishes. His modesty disposed him to decline the honour of the Moderatorship a second time, and he was afraid that his constitution, which never was robust, and now much weaker than when he held that office eleven years before, might not be equal to the fatigues in which he would necessarily be involved. Besides, he was extremely unwilling to put his friends to the trouble of coming from the remote parts of the country on his account. By earnest solicitation, and particularly when it was strongly stated to him, that he ought not to consider this as his own cause only, but the cause of the friends with whom he had always acted, his objections at last were removed ; and as it was a maxim of his never to do things by halves, he determined to use his utmost exertions in collecting such a support as might justify the favourable opinion that had been formed of him. Accordingly, on the meeting of the Assembly, though a most respectable clergyman was named as the other candidate, Dr DRYSDALE, by a very great majority of votes, was seated a second time in the Moderator's chair.

THIS was the last great exertion which he made. His friend Dr ROBERTSON had, some years before, declined all concern in the public affairs of the Church ; since which time it was supposed, that Dr DRYSDALE possessed more influence among his brethren than any other individual ; and this Assembly afforded a clear proof of it. No person had appeared so eloquent, or possessed of talents so fit for a leader in the Assembly, as Dr ROBERTSON. But after he withdrew, the conduct of the debates in that house seemed to be shared among a number of speakers ; and while the claim of no single person was admitted to be the ostensible leader, it was well known, that the prudence and the influence of Dr DRYSDALE had the greatest

est share in guiding all the measures of his party, while he himself claimed no merit, and had no pretensions.

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He had been for a long time so well acquainted with the state of the two parties in the Church, that he used to calculate, with surprising exactness, what the issue of the votes would be in almost all the great questions that came before the Assembly. He would often, with that good humour which marked all his conversation, tell his acquaintance of the opposite party, by how many votes they would lose the question; and however sanguine at first they might be, they knew him so well, that they seldom disputed his accuracy.

His health was now greatly on the decline. So long before as the end of the year 1773, his constitution had received a shock, which, though visible to his own family, did not yet appear to his other friends. Death had deprived him of several of his children; and being a most affectionate parent, he was always extremely affected with the loss of them: And that year added to his former distresses the death of his youngest daughter, a most beautiful and promising child. With this he continued to be so much affected, that several years afterwards, when he was inculcating upon his audience the important lesson, "That man knows not what is good for him in this life;" and was observed, in one part of his discourse, to be agitated with uncommon emotion; it was evident to his friends, that he alluded to his own situation.

Though his constitution continued to be gradually enfeebled, he still discharged the public duties of his ministry with little intermission; and it was observed, that the annual approach of the General Assembly always inspired him with unusual animation. For several years, he had taken upon him the whole duty of the clerkship, exerting himself also, in every other respect, for the relief of Dr WISHART, his venerable colleague, now far advanced in life, till, in the year 1785, he

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lost that truly respectable and valuable friend. He preached a sermon on that occasion from the following words: *Let me die the death of the righteous, and let my last end be like his;* and though, by that time, his powers of composition, and the energy of his delivery, were much abated, he paid an affectionate tribute to the memory of the much-respected partner of his labours, whose character, in describing that of the righteous man throughout the first part of the discourse, he plainly alluded to, and in the conclusion delineated in direct terms.

AFTER this time, it was evident, not only to his particular friends, but also to his hearers, that the strength both of his mind and body was considerably impaired. The decline of his health was much accelerated by a severe cough, to which he had long been subject. He continued, however, occasionally to preach, though his discourses wanted that energy, both in composition and delivery, which used to distinguish them.

FOR some years during the sitting of the General Assemblies, when he felt the discharge of the duty of Principal Clerk at times too fatiguing for him, he was allowed to retire, and one of the assistant clerks officiated in his stead. At the meeting of the Assembly in May 1788, he appeared in his place, and acted as Principal Clerk the first day; but finding his strength unequal to the remaining parts of the duty, on the second day he requested permission of the Court to be assisted by his friend and relation*, who now pays this willing tribute to his memory, and his request was unanimously granted.

BUT he did not long survive the Assembly of that year. Early in the month of June, his cough attacked him with extraordinary violence, and soon weakened him so much, that he could no longer rise from his bed. He still, however, retained

* The husband of his eldest daughter. (D)

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his wonted endearing manner to his family,—only less animated, but affecting in the utmost degree. Thus he continued to grow weaker and weaker, until his constitution at last seemed to be quite worn out; and in him the Church of Scotland lost one of her greatest ornaments, on the 16th of June 1788.

Such was the conclusion of the well-spent life of this excellent person; whose integrity was inflexible, whose amiable conversation and manners were expressive of the extreme worth and benevolence of his heart, whose respectable character adorned his sacred profession, and who was the delight of his friends and of his family. Though gentle, unsuspecting and candid, in an extraordinary degree, yet, as his soul was inspired with that noble elevation which arises from conscious virtue and freedom from all deceit, his indignation was excited whenever he detected in others any duplicity in conduct, or any deviation from the road of honour. As in his public appearances, the energy and animation with which he delivered and enforced his instructions, carried a conviction that they flowed directly from the heart; so it was universally allowed by all those who were acquainted with his private life, that never any man more successfully illustrated what he taught by his own conduct and manners. His charity to the indigent was as extensive as his circumstances would admit, and in some cases went far beyond what ordinary men would deem to be consistent with prudence. He took the greatest pleasure in protecting, encouraging and bringing forward young men, who seemed to him to be possessed of talents which promised to be useful in those situations which were the objects of their pursuit either in Church or State, and he was indefatigable in availing himself of every opportunity to serve them. He lived to have the satisfaction of seeing many of them successful in life; but no one ever observed him arrogating any merit to himself on that account, or even betraying a single expression which might

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seem to hint a claim on their gratitude. It is not therefore surprising that he was so much beloved by his younger friends.

BUT Dr DRYSDALE continued also to enjoy the affection of the friends of his youth. Mr OSWALD, Dr SMITH and Dr ROBERTSON, have been already mentioned. Though his intercourse with Dr SMITH had been, in consequence of the distance of their situation, less frequent for many years than they could have wished, yet they used to meet occasionally in their native town, to which they were always fondly attached; and there, in company with Mr OSWALD, and some other companions less known to fame, they spent many of the most pleasant hours of their life. When afterwards Dr SMITH came to reside in Edinburgh, they then associated together with less interruption; nor was there any one among all the numerous friends and acquaintance of that excellent man whom he loved with greater affection, or spoke of with greater tenderness, than JOHN DRYSDALE. Two other intimate friends of Dr DRYSDALE's earlier years, and on whom he had set a great value, died long before him. These were MR WILLIAM CLEGHORN and Dr WILLIAM WILKIE; the former of whom was the immediate successor of the late Sir JOHN PRINGLE in the Professorship of Moral Philosophy in the University of Edinburgh, a young man of great genius, and from whom much was expected; but he was cut off in the flower of youth: the latter known to the public as the author of the Epigoniad, and Fables in Verse, was distinguished also among a numerous circle of literary friends for extensive and profound erudition, for a copious and inexhaustible flow of original, amusing and instructing conversation, and likewise for some whimsical and diverting peculiarities of character. With the family of the ADAMS, whose genius and taste in the elegant arts of architecture and designing, have vied with the talents of the poet, the historian, and the philosopher, in reflecting lustre on their native land, Dr DRYSDALE long lived in a constant reciprocation of good offices,

both as the much respected relation, and as the intimate friend. His wife MARY ADAM, and two daughters, compose his surviving family. He has left likewise behind him a brother, whom he loved with the most ardent affection, GEORGE DRYSDALE, Esq; formerly Provost of Kirkaldy, and now Collector of the customs in that town, the steady and much-esteemed friend also of the late Mr OSWALD and Dr SMITH, and when they visited the place of their nativity, the companion of their social hours.

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To those who were not intimately acquainted with the subject of the foregoing narrative, the language of eulogy may seem to have been admitted to too great an extent; and exaggeration of praise may be suspected, merely because such virtuous men as the late Dr DRYSDALE are not often to be found. Those, however, who knew him best will give their cordial assent to what has been said; for in all that has been asserted, truth has been aimed at, and the language of panegyric may accord sometimes with the dictates of truth.

SINCE Dr DRYSDALE's death, two volumes of his sermons have been published, which will be a lasting monument of his admirable talents as a Preacher; being, in the opinion of competent judges, compositions of the highest excellence, and evidently the productions of a mind of a superior order.

has written base trifles, and vociferous pretensions to great merit, and
the author of the present work has had the good fortune to be enabled to
see through his浅見, as it were, and to expose the fallacy of his claims.

III. ACCOUNT of the LIFE and WRITINGS of ADAM SMITH, LL.D.

[Read by Mr STEWART, Jan. 21. and March 18. 1793.]

THE life of Adam Smith, the author of the Theory of Moral Sentiments, and of the Wealth of Nations, is a history of his own times, and of the manners and customs of the people of Scotland. He was born at Kirkaldy, in Fife, on the 5th of June 1723, and died at Edinburgh on the 17th of July 1790. His life may be divided into three periods:—

SECTION I.

From Mr SMITH's Birth till the Publication of the Theory of Moral Sentiments.

ADAM SMITH, Author of the Inquiry into the Nature and Causes of the Wealth of Nations, was the son of ADAM SMITH, Comptroller of the Customs at Kirkaldy*, and of MARGARET DOUGLAS, daughter of Mr DOUGLAS of Strathenry. He was the only child of the marriage, and was born at Kirkaldy on the 5th of June 1723, a few months after the death of his father.

His

* Mr SMITH, the father, was a native of Aberdeenshire, and in the earlier part of his life practised at Edinburgh as a writer to the Signet. He was afterwards private secretary to the Earl of Loudoun, (during the time that he held the offices of principal Secretary of State for Scotland, and of Keeper of the Great Seal), and continued in his employment till 1713 or 1714, when he was appointed comptroller of the customs at Kirkaldy. He was also clerk to the courts martial and councils of war for Scotland; an office which he held from 1707 till his death. As it is now seventy years since he died, the accounts I have received of him are very imperfect; but from the particulars already mentioned, it may be presumed, that he was a man of more than common abilities.

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Dr Smith.

His constitution during infancy was infirm and sickly, and required all the tender solicitude of his surviving parent. She was blamed for treating him with an unlimited indulgence; but it produced no unfavourable effects on his temper or his dispositions:—and he enjoyed the rare satisfaction of being able to repay her affection, by every attention that filial gratitude could dictate, during the long period of sixty years.

AN accident, which happened to him when he was about three years old, is of too interesting a nature to be omitted in the account of so valuable a life. He had been carried by his mother to Strathenry on a visit to his uncle Mr DOUGLAS, and was one day amusing himself alone at the door of the house, when he was stolen by a party of that set of vagrants who are known in Scotland by the name of tinkers. Luckily he was soon missed by his uncle, who hearing that some vagrants had passed, pursued them, with what assistance he could find, till he overtook them in Leslie wood; and was the happy instrument of preserving to the world a genius, which was destined, not only to extend the boundaries of science, but to enlighten and reform the commercial policy of Europe.

THE school of Kirkaldy, where Mr SMITH received the first rudiments of his education, was then taught by Mr DAVID MILLER, a teacher, in his day, of considerable reputation, and whose name deserves to be recorded, on account of the eminent men whom that very obscure seminary produced while under his direction. Mr OSWALD of Dunikeir, whose profound knowledge of finances raised him afterwards to important employments in the State, and to a distinguished rank as a Parliamentary speaker; his brother, Dr JOHN OSWALD, afterwards Bishop of Raphoe; and Dr JOHN DRYSDALE, whose talents and worth are well known to this Society, were among the number of Mr SMITH's contemporaries.—One of his school-fellows is still alive*; and to his kindness I am principally indebted for the

* GEORGE DRYSDALE, Esq; of Kirkaldy, brother of the late Dr DRYSDALE.

the scanty materials, which form the first part of this narrative.

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AMONG these companions of his earliest years, MR SMITH soon attracted notice, by his passion for books, and by the extraordinary powers of his memory. The weakness of his bodily constitution prevented him from partaking in their more active amusements ; but he was much beloved by them on account of his temper, which, though warm, was to an uncommon degree friendly and generous. Even then he was remarkable for those habits which remained with him through life, of speaking to himself when alone, and of *absence* in company.

FROM the grammar-school of Kirkaldy, he was sent, in 1737, to the University of Glasgow, where he remained till 1740, when he went to Balliol College, Oxford, as an exhibitioner on SNELL's foundation.

DR MACLAINE of the Hague, who was a fellow-student of MR SMITH's at Glasgow, told me some years ago, that his favourite pursuits while at that University were Mathematics and Natural Philosophy ; and I remember to have heard my father remind him of a geometrical problem of considerable difficulty, about which he was occupied at the time when their acquaintance commenced, and which had been proposed to him as an exercise by the celebrated DR SIMPSON.

THESE, however, were certainly not the sciences in which he was formed to excel ; nor did they long divert him from pursuits more congenial to his mind. What Lord BACON says of PLATO may be justly applied to him : " Illum, licet ad " rempublicam non accessisset, tamen naturâ et inclinatione " omnino ad res civiles propensum, vires eo præcipue intendisse ; " neque de Philosophia Naturali admodum sollicitum esse ; nisi " quatenus ad Philosophi nomen et celebritatem tuendam, et " ad majestatem quandam moralibus et civilibus doctrinis ad- " dendam et aspergendarum sufficeret.*." The study of human

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* Redargutio Philosophiarum.

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nature in all its branches, more particularly of the political history of mankind, opened a boundless field to his curiosity and ambition ; and while it afforded scope to all the various powers of his versatile and comprehensive genius, gratified his ruling passion, of contributing to the happiness and the improvement of society. To this study, diversified at his leisure hours by the less severe occupations of polite literature, he seems to have devoted himself almost entirely from the time of his removal to Oxford ; but he still retained, and retained even in advanced years, a recollection of his early acquisitions, which not only added to the splendour of his conversation, but enabled him to exemplify some of his favourite theories concerning the natural progress of the mind in the investigation of truth, by the history of those sciences in which the connection and succession of discoveries may be traced with the greatest advantage. If I am not mistaken too, the influence of his early taste for the Greek geometry may be remarked in the elementary clearness and fulness, bordering sometimes upon prolixity, with which he frequently states his political reasonings.—The lectures of the profound and eloquent Dr HUTCHESON, which he had attended previous to his departure from Glasgow, and of which he always spoke in terms of the warmest admiration, had, it may be reasonably presumed, a considerable effect in directing his talents to their proper objects.

I HAVE not been able to collect any information with respect to that part of his youth which was spent in England. I have heard him say, that he employed himself frequently in the practice of translation, (particularly from the French), with a view to the improvement of his own style : and he used often to express a favourable opinion of the utility of such exercises, to all who cultivate the art of composition. It is much to be regretted, that none of his juvenile attempts in this way have been preserved ; as the few specimens which his writings contain of his skill as a translator, are sufficient to shew the eminence he had attained in a walk of literature,

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which, in our country, has been so little frequented by men of genius.

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IT was probably also at this period of his life, that he cultivated with the greatest care the study of languages. The knowledge he possessed of these, both ancient and modern, was uncommonly extensive and accurate ; and, in him, was subservient, not to a vain parade of tasteless erudition, but to a familiar acquaintance with every thing that could illustrate the institutions, the manners and the ideas of different ages and nations. How intimately he had once been conversant with the more ornamental branches of learning ; in particular, with the works of the Roman, Greek, French and Italian poets, appeared sufficiently from the hold which they kept of his memory, after all the different occupations and enquiries in which his maturer faculties had been employed *. In the English language, the variety of poetical passages which he was not only accustomed to refer to occasionally, but which he was able to repeat with correctness, appeared surprising even to those, whose attention had never been directed to more important acquisitions.

AFTER a residence at Oxford of seven years, he returned to Kirkaldy, and lived two years with his mother ; engaged in study, but without any fixed plan for his future life. He had been originally destined for the Church of England, and with that view had been sent to Oxford ; but not finding the ecclesiastical profession suitable to his taste, he chose to consult, in this instance, his own inclination, in preference to the wishes of his friends ; and abandoning at once all the schemes which

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* THE uncommon degree in which MR SMITH retained possession, even to the close of his life, of different branches of knowledge which he had long ceased to cultivate, has been often remarked to me by my learned colleague and friend, MR DALZEL, Professor of Greek in this University.—MR DALZEL mentioned particularly the readiness and correctness of MR SMITH's memory on philological subjects, and the acuteness and skill he displayed in various conversations with him on some of the *minutiae* of Greek grammar.

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their prudence had formed for him, he resolved to return to his own country, and to limit his ambition to the uncertain prospect of obtaining, in time, some one of those moderate preferments, to which literary attainments lead in Scotland.

IN the year 1748, he fixed his residence at Edinburgh, and during that and the following years, read lectures on rhetoric and belles lettres, under the patronage of Lord KAMES. About this time, too, he contracted a very intimate friendship, which continued, without interruption, till his death, with Mr ALEXANDER WEDDERBURN, now Lord LOUGHBOROUGH, and with Mr WILLIAM JOHNSTONE, now Mr PULTENEY.

AT what particular period his acquaintance with Mr DAVID HUME commenced, does not appear from any information that I have received; but from some papers, now in the possession of Mr HUME's nephew, and which he has been so obliging as to allow me to peruse, their acquaintance seems to have grown into friendship before the year 1752. It was a friendship on both sides founded on the admiration of genius, and the love of simplicity; and which forms an interesting circumstance in the history of each of these eminent men, from the ambition which both have shewn to record it to posterity.

IN 1751, he was elected Professor of Logic in the University of Glasgow; and, the year following, he was removed to the Professorship of Moral Philosophy in the same University, upon the death of Mr THOMAS CRAIGIE, the immediate successor of Dr HUTCHESON. In this situation, he remained thirteen years; a period he used frequently to look back to, as the most useful and happy of his life. It was indeed a situation in which he was eminently fitted to excel, and in which the daily labours of his profession were constantly recalling his attention to his favourite pursuits, and familiarising his mind to those important speculations he was afterwards to communicate to the world. In this view, though it afforded, in the mean time, but a very narrow scene for his ambition, it was probably instrumental, in no inconsiderable degree, to the future eminence of his literary character.

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OF MR SMITH's lectures while a Professor at Glasgow, no part has been preserved, excepting what he himself published in the Theory of Moral Sentiments and in the Wealth of Nations. The Society therefore, I am persuaded, will listen with pleasure to the following short account of them, for which I am indebted to a gentleman who was formerly one of Mr SMITH's pupils, and who continued till his death to be one of his most intimate and valued friends.

" IN the Professorship of Logic, to which MR SMITH was appointed on his first introduction into this University, he soon saw the necessity of departing widely from the plan that had been followed by his predecessors, and of directing the attention of his pupils to studies of a more interesting and useful nature than the logic and metaphysics of the schools. Accordingly, after exhibiting a general view of the powers of the mind, and explaining so much of the ancient logic as was requisite to gratify curiosity with respect to an artificial method of reasoning, which had once occupied the universal attention of the learned, he dedicated all the rest of his time to the delivery of a system of rhetoric and belles lettres. The best method of explaining and illustrating the various powers of the human mind, the most useful part of metaphysics, arises from an examination of the several ways of communicating our thoughts by speech, and from an attention to the principles of those literary compositions, which contribute to persuasion or entertainment. By these arts, every thing that we perceive or feel, every operation of our minds, is expressed and delineated in such a manner, that it may be clearly distinguished and remembered. There is, at the same time, no branch of literature more suited to youth at their first entrance upon philosophy than this, which lays hold of their taste and their feelings.

" IT is much to be regretted, that the manuscript containing MR SMITH's lectures on this subject was destroyed before his death. The first part, in point of composition, was highly finished;

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finished ; and the whole discovered strong marks of taste and original genius. From the permission given to students of taking notes, many observations and opinions contained in these lectures, have either been detailed in separate dissertations, or ingrossed in general collections, which have since been given to the public. But these, as might be expected, have lost the air of originality and the distinctive character which they received from their first author, and are often obscured by that multiplicity of common-place matter in which they are sunk and involved.

" ABOUT a year after his appointment to the Professorship of Logic, MR SMITH was elected to the chair of Moral Philosophy. His course of lectures on this subject was divided into four parts. The first contained Natural Theology ; in which he considered the proofs of the being and attributes of GOD, and those principles of the human mind upon which religion is founded. The second comprehended Ethics strictly so called, and consisted chiefly of the doctrines which he afterwards published in his Theory of Moral Sentiments. In the third part, he treated at more length of that branch of morality which relates to *justice*, and which, being susceptible of precise and accurate rules, is, for that reason, capable of a full and particular explanation.

" UPON this subject, he followed the plan that seems to be suggested by MONTESQUIEU ; endeavouring to trace the gradual progress of jurisprudence, both public and private, from the rudest to the most refined ages, and to point out the effects of those arts which contribute to subsistence, and to the accumulation of property, in producing correspondent improvements or alterations in law and government. This important branch of his labours he also intended to give to the public ; but this intention, which is mentioned in the conclusion of the Theory of Moral Sentiments, he did not live to fulfil.

" IN the last part of his lectures, he examined those political regulations which are founded, not upon the principle of *justice*,

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justice, but that of *expediency*, and which are calculated to increase the riches, the power and the prosperity of a State. Under this view, he considered the political institutions relating to commerce, to finances, to ecclesiastical and military establishments. What he delivered on these subjects contained the substance of the work he afterwards published under the title of *An Inquiry into the Nature and Causes of the Wealth of Nations*.

" THERE was no situation in which the abilities of Mr SMITH appeared to greater advantage than as a Professor. In delivering his lectures, he trusted almost entirely to extemporary elocution. His manner, though not graceful, was plain and unaffected; and as he seemed to be always interested in the subject, he never failed to interest his hearers. Each discourse consisted commonly of several distinct propositions, which he successively endeavoured to prove and illustrate. These propositions, when announced in general terms, had, from their extent, not unfrequently something of the air of a paradox. In his attempts to explain them, he often appeared, at first, not to be sufficiently possessed of the subject, and spoke with some hesitation. As he advanced, however, the matter seemed to crowd upon him, his manner became warm and animated, and his expression easy and fluent. In points susceptible of controversy, you could easily discern, that he secretly conceived an opposition to his opinions, and that he was led upon this account to support them with greater energy and vehemence. By the fulness and variety of his illustrations, the subject gradually swelled in his hands, and acquired a dimension which, without a tedious repetition of the same views, was calculated to seize the attention of his audience, and to afford them pleasure, as well as instruction, in following the same object, through all the diversity of shades and aspects in which it was presented, and afterwards in tracing it backwards to that original

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ginal proposition or general truth, from which this beautiful train of speculation had proceeded.

" His reputation as a Professor was accordingly raised very high, and a multitude of students from a great distance resort-
ed to the University, merely upon his account. Those branches
of science which he taught became fashionable at this place,
and his opinions were the chief topics of discussion in clubs and
literary societies. Even the small peculiarities in his pronun-
ciation or manner of speaking, became frequently the objects
of imitation."

WHILE MR SMITH was thus distinguishing himself by his
zeal and ability as a public teacher, he was gradually laying the
foundation of a more extensive reputation, by preparing for
the press his system of morals. The first edition of this work
appeared in 1759, under the title of "The Theory of Moral
Sentiments."

HITHERTO MR SMITH had remained unknown to the world
as an author; nor have I heard that he had made a trial of his
powers in any anonymous publications, excepting in a periodical
work called *The Edinburgh Review*, which was begun in the
year 1755, by some gentlemen of distinguished abilities, but
which they were prevented by other engagements from carrying
farther than the two first numbers. To this work MR SMITH
contributed a review of DR JOHNSON'S Dictionary of the English
Language, and also a letter, addressed to the editors, con-
taining some general observations on the state of literature
in the different countries of Europe. In the former of
these papers, he points out some defects in DR JOHNSON'S plan,
which he censures as not sufficiently grammatical. " The
" different significations of a word (he observes) are indeed
" collected; but they are seldom digested into general classes,
" or ranged under the meaning which the word principally ex-
" presses: And sufficient care is not taken to distinguish the

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"words apparently synonymous." To illustrate this criticism, he copies from Dr JOHNSON the articles BUT and HUMOUR, and opposes to them the same articles digested agreeably to his own idea. The various significations of the word BUT are very nicely and happily discriminated. The other article does not seem to have been executed with equal care.

THE observations on the state of learning in Europe are written with ingenuity and elegance; but are chiefly interesting, as they shew the attention which the Author had given to the philosophy and literature of the Continent, at a period when they were not much studied in this island.

IN the same volume with the Theory of Moral Sentiments, Mr SMITH published a Dissertation "on the Origin of Languages, and on the different Genius of those which are original and compounded." The remarks I have to offer on these two discourses, I shall, for the sake of distinctness, make the subject of a separate section.

S E C T I O N II.

Of the Theory of Moral Sentiments, and the Dissertation on the Origin of Languages.

THE science of Ethics has been divided by modern writers into two parts; the one comprehending the theory of Morals, and the other its practical doctrines. The questions about which the former is employed, are chiefly the two following. *First,* By what principle of our constitution are we led to form the notion of moral distinctions;—whether by that faculty which perceives the distinction between truth

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and falsehood ; or by a peculiar power of perception, which is pleased with one set of qualities, and displeased with another ? Secondly, What is the proper object of moral approbation ; or, in other words, what is the common quality or qualities belonging to all the different modes of virtue ? Is it benevolence ; or a rational self-love ; or a disposition to act suitably to the different relations in which we are placed ? These two questions seem to exhaust the whole theory of morals. The scope of the one is to ascertain the origin of our moral ideas ; that of the other, to refer the phenomena of moral perception to their most simple and general laws.

THE practical doctrines of morality comprehend all those rules of conduct which profess to point out the proper ends of human pursuit, and the most effectual means of attaining them ; to which we may add all those literary compositions, whatever be their particular form, which have for their aim to fortify and animate our good dispositions, by delineations of the beauty, of the dignity, or of the utility of Virtue.

I SHALL not enquire at present into the justness of this division. I shall only observe, that the words Theory and Practice are not, in this instance, employed in their usual acceptations. The theory of morals does not bear, for example, the same relation to the practice of morals, that the theory of geometry bears to practical geometry. In this last science, all the practical rules are founded on theoretical principles previously established : But in the former science, the practical rules are obvious to the capacities of all mankind ; the theoretical principles form one of the most difficult subjects of discussion that have ever exercised the ingenuity of metaphysicians.

IN illustrating the doctrines of practical morality, (if we make allowance for some unfortunate prejudices produced or encouraged by violent and oppressive systems of policy), the ancients seem to have availed themselves of every light furnished by nature to human reason ; and indeed those writers who, in

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later times, have treated the subject with the greatest success, are they who have followed most closely the footsteps of the Greek and the Roman philosophers. The theoretical question, too, concerning the essence of virtue, or the proper *object* of moral approbation, was a favourite topic of discussion in the ancient schools. The question concerning the *principle* of moral approbation, though not entirely of modern origin, has been chiefly agitated since the writings of Dr CUDWORTH, in opposition to those of Mr HOBSES; and it is this question accordingly, (recommended, at once, by its novelty and difficulty to the curiosity of speculative men), that has produced most of the theories which characterise and distinguish from each other the later systems of moral philosophy.

IT was the opinion of Dr CUDWORTH and also of Dr CLARKE, that moral distinctions are perceived by that power of the mind which distinguishes truth from falsehood. This system it was one great object of Dr HUTCHESON's philosophy to refute, and in opposition to it, to shew, that the words Right and Wrong express certain agreeable and disagreeable qualities in actions, which it is not the province of reason but of feeling to perceive; and to that power of perception which renders us susceptible of pleasure or of pain from the view of virtue or of vice, he gave the name of the Moral Sense. His reasonings upon this subject are in the main acquiesced in, both by Mr HUME and Mr SMITH; but they differ from him in one important particular,—Dr HUTCHESON plainly supposing, that the moral sense is a simple principle of our constitution, of which no account can be given; whereas the other two philosophers have both attempted to analyse it into other principles more general. Their systems, however, with respect to it are very different from each other. According to Mr HUME, all the qualities which are denominated virtuous, are useful either to ourselves or to others, and the pleasure which we derive from the view of them is the pleasure of utility. Mr SMITH, with-

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out rejecting entirely Mr HUME's doctrine, proposes another of his own, far more comprehensive; a doctrine with which he thinks all the most celebrated theories of morality invented by his predecessors coincide in part, and from some partial view of which he apprehends that they have all proceeded.

Of this very ingenious and original theory, I shall endeavour to give a short abstract. To those who are familiarly acquainted with it as it is stated by its Author, I am aware that the attempt may appear superfluous; but I flatter myself that it will not be wholly useless to such as have not been much conversant in these abstract disquisitions, by presenting to them the leading principles of the system in one connected view, without those interruptions of the attention which necessarily arise from the Author's various and happy illustrations, and from the many eloquent digressions which animate and adorn his composition.

THE fundamental principle of Mr SMITH's theory is, that the primary objects of our moral perceptions are the actions of other men; and that our moral judgments with respect to our own conduct are only applications to ourselves of decisions which we have already passed on the conduct of our neighbour. His work accordingly consists of two parts. In the former, he explains in what manner we learn to judge of the conduct of our neighbour; in the latter, in what manner, by applying these judgments to ourselves, we acquire *a sense of duty*.

OUR moral judgments, both with respect to our own conduct and that of others, include two distinct perceptions: *first*, A perception of conduct as right or wrong; and, *secondly*, A perception of the merit or demerit of the agent. To that quality of conduct which moralists, in general, express by the word Rectitude, Mr SMITH gives the name of Propriety; and he begins

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gins his theory with enquiring in what it consists, and how we are led to form the idea of it. The leading principles of his doctrine on this subject are comprehended in the following propositions.

1. It is from our own experience alone, that we can form any idea of what passes in the mind of another person on any particular occasion ; and the only way in which we can form this idea, is by supposing ourselves in the same circumstances with him, and conceiving how we should be affected if we were so situated. It is impossible for us, however, to conceive ourselves placed in any situation, whether agreeable or otherwise, without feeling an effect of the same kind with what would be produced by the situation itself ; and of consequence the attention we give at any time to the circumstances of our neighbour, must affect us somewhat in the same manner, although by no means in the same degree, as if these circumstances were our own.

THAT this imaginary change of place with other men, is the real source of the interest we take in their fortunes, Mr SMITH attempts to prove by various instances. " When we see a stroke aimed, and just ready to fall upon the leg or arm of another person, we naturally shrink and draw back our own leg or our own arm ; and when it does fall, we feel it in some measure, and are hurt by it as well as the sufferer. The mob, when they are gazing at a dancer on the slack rope, naturally writhe and twist and balance their own bodies, as they see him do, and as they feel that they themselves must do if in his situation." The same thing takes place, according to Mr SMITH, in every case in which our attention is turned to the condition of our neighbour. " Whatever is the passion which arises from any object in the person principally concerned, an analogous emotion springs up, at the thought of his situation, in the breast of every attentive spectator. In every passion of which the mind of man is susceptible,

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" the emotions of the by-stander always correspond to what,
" by bringing the case home to himself, he imagines should be
" the sentiments of the sufferer."

To this principle of our nature which leads us to enter into the situations of other men, and to partake with them in the passions which these situations have a tendency to excite, Mr SMITH gives the name of *sympathy* or *fellow-feeling*, which two words he employs as synonymous. Upon some occasions, he acknowledges, that sympathy arises merely from the view of a certain emotion in another person; but in general it arises, not so much from the view of the emotion, as from that of the situation which excites it.

2. A SYMPATHY or fellow-feeling between different persons is always agreeable to both. When I am in a situation which excites any passion, it is pleasant to me to know, that the spectators of my situation enter with me into all its various circumstances, and are affected with them in the same manner as I am myself. On the other hand, it is pleasant to the spectator to observe this correspondence of his emotions with mine.

3. WHEN the spectator of another man's situation, upon bringing home to himself all its various circumstances, feels himself affected in the same manner with the person principally concerned, he approves of the affection or passion of this person as just and proper and suitable to its object. The exceptions which occur to this observation are, according to Mr SMITH, only apparent. " A stranger, for example, passes by " us in the street with all the marks of the deepest affliction ; " and we are immediately told, that he has just received the " news of the death of his father. It is impossible that, in this " case, we should not approve of his grief ; yet it may often " happen, without any defect of humanity on our part, that, " so far from entering into the violence of his sorrow, we " should scarce conceive the first movements of concern upon " his account. We have learned, however, from experience,

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" that such a misfortune naturally excites such a degree of sorrow ; and we know, that if we took time to examine his situation fully and in all its parts, we should, without doubt, most sincerely sympathize with him. It is upon the consciousness of this conditional sympathy that our approbation of his sorrow is founded, even in those cases in which that sympathy does not actually take place ; and the general rules derived from our preceding experience of what our sentiments would commonly correspond with, correct upon this, as upon many other occasions, the impropriety of our present emotions."

By the *propriety* therefore of any affection or passion exhibited by another person, is to be understood its suitableness to the object which excites it. Of this suitableness I can judge only from the coincidence of the affection with that which I feel, when I conceive myself in the same circumstances ; and the perception of this coincidence is the foundation of the sentiment of *moral approbation*.

4. ALTHOUGH, when we attend to the situation of another person, and conceive ourselves to be placed in his circumstances, an emotion of the same kind with that which he feels, naturally arises in our own mind, yet this sympathetic emotion bears but a very small proportion, in point of degree, to what is felt by the person principally concerned. In order, therefore, to obtain the pleasure of mutual sympathy, nature teaches the spectator to strive as much as he can to raise his emotion to a level with that which the object would really produce ; and, on the other hand, she teaches the person whose passion this object has excited, to bring it down, as much as he can, to a level with that of the spectator.

5. UPON these two different efforts are founded two different sets of virtues. Upon the effort of the spectator to enter into the situation of the person principally concerned, and to raise his sympathetic emotions to a level with the emotions of the actor,

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actor, are founded the gentle, the amiable virtues; the virtues of candid condescension and indulgent humanity. Upon the effort of the person principally concerned to lower his own emotions, so as to correspond as nearly as possible with those of the spectator, are founded the great, the awful and respectable virtues; the virtues of self-denial, of self-government, of that command of the passions, which subjects all the movements of our nature to what our own dignity and honour, and the propriety of our own conduct, require.

As a farther illustration of the foregoing doctrine, Mr SMITH considers particularly the degrees of the different passions which are consistent with propriety, and endeavours to shew, that in every case, it is decent or indecent to express a passion strongly, according as mankind are disposed or not disposed to sympathize with it. It is unbecoming, for example, to express strongly any of those passions which arise from a certain condition of the body; because other men, who are not in the same condition, cannot be expected to sympathize with them. It is unbecoming to cry out with bodily pain; because the sympathy felt by the spectator bears no proportion to the acuteness of what is felt by the sufferer. The case is somewhat similar with those passions which take their origin from a particular turn or habit of the imagination.

IN the case of the unsocial passions of hatred and resentment, the sympathy of the spectator is divided between the person who feels the passion, and the person who is the object of it. " We are concerned for both, and our fear [for what " the one may suffer damps our resentment for what the other " has suffered." Hence the imperfect degree in which we sympathize with such passions; and the propriety, when we are under their influence, of moderating their expression to a much greater degree than is required in the case of any other emotions.

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THE reverse of this takes place with respect to all the social and benevolent affections. The sympathy of the spectator with the person who feels them, coincides with his concern for the person who is the object of them. It is this redoubled sympathy which renders these affections so peculiarly becoming and agreeable.

THE selfish emotions of grief and joy, when they are conceived on account of our own private good or bad fortune, hold a sort of middle place between our social and our unsocial passions. They are never so graceful as the one set, nor so odious as the other. Even when excessive, they are never so disagreeable as excessive resentment; because no opposite sympathy can ever interest us against them: And when most suitable to their objects, they are never so agreeable as impartial humanity and just benevolence; because no double sympathy can ever interest us for them.

AFTER these general speculations concerning the propriety of actions, MR SMITH examines how far the judgments of mankind concerning it are liable to be influenced in particular cases, by the prosperous or the adverse circumstances of the agent. The scope of his reasoning on this subject is directed to shew, (in opposition to the common opinion), that when there is no envy in the case, our propensity to sympathize with joy is much stronger than our propensity to sympathize with sorrow; and, of consequence, that it is more easy to obtain the approbation of mankind in prosperity than in adversity. From the same principle he traces the origin of ambition, or of the desire of rank and pre-eminence; the great object of which passion is, to attain that situation which sets a man most in the view of general sympathy and attention, and gives him an easy empire over the affections of others.

HAVING finished the analysis of our sense of propriety and of impropriety, MR SMITH proceeds to consider our sense of merit

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and demerit; which he thinks has also a reference, in the first instance, not to our own characters, but to the characters of our neighbours. In explaining the origin of this part of our moral constitution, he avails himself of the same principle of sympathy, into which he resolves the sentiment of moral approbation.

THE words *propriety* and *impropriety*, when applied to an affection of the mind, are used in this theory (as has been already observed) to express the suitableness or unsuitableness of the affection to its exciting *cause*. The words *merit* and *demerit* have always a reference (according to Mr SMITH) to the effect which the affection tends to produce. When the tendency of an affection is beneficial, the agent appears to us a proper object of reward; when it is hurtful, he appears the proper object of punishment.

THE principles in our nature which most directly prompt us to reward and to punish, are gratitude and resentment. To say of a person, therefore, that he is deserving of reward or of punishment, is to say, in other words, that he is a proper object of gratitude or of resentment; or, which amounts to the same thing, that he is to some person or persons the object of a gratitude or of a resentment, which every reasonable man is ready to adopt and sympathize with.

IT is however very necessary to observe, that we do not thoroughly sympathize with the gratitude of one man towards another, merely because this other has been the cause of his good fortune, unless he has been the cause of it from motives which we entirely go along with. Our sense, therefore, of the good desert of an action, is a compounded sentiment, made up of an indirect sympathy with the person to whom the action is beneficial, and of a direct sympathy with the affections and motives of the agent.—The same remark applies, *mutatis mutandis*, to our sense of demerit, or of ill-desert.

FROM these principles, it is inferred, that the only actions which appear to us deserving of reward, are actions of a beneficial

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ficial tendency, proceeding from proper motives; the only actions which seem to deserve punishment, are actions of a hurtful tendency, proceeding from improper motives. A mere want of beneficence exposes to no punishment; because the mere want of beneficence tends to do no real positive evil. A man, on the other hand, who is barely innocent, and contents himself with observing strictly the laws of justice with respect to others, can merit only that his neighbours, in their turn, should observe religiously the same laws with respect to him.

THESE observations lead MR SMITH to anticipate a little the subject of the second great division of his work, by a short enquiry into the origin of our sense of justice *as applicable to our own conduct*; and also of our sentiments of remorse, and of good desert.

THE origin of our sense of justice, as well as of all our other moral sentiments, he accounts for by means of the principle of sympathy. When I attend only to the feelings of my own breast, my own happiness appears to me of far greater consequence than that of all the world besides. But I am conscious, that in this excessive preference, other men cannot possibly sympathize with me, and that to them I appear only one of the crowd, in whom they are no more interested than in any other individual. If I wish, therefore, to secure their sympathy and approbation, (which, according to MR SMITH, are the objects of the strongest desire of my nature), it is necessary for me to regard my happiness, not in that light in which it appears to myself, but in that light in which it appears to mankind in general. If an unprovoked injury is offered to me, I know that society will sympathize with my resentment; but if I injure the interests of another, who never injured me, merely because they stand in the way of my own, I perceive evidently, that society will sympathize with his resentment, and that I shall become the object of general indignation.

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WHEN, upon any occasion, I am led by the violence of passion to overlook these considerations, and, in the case of a competition of interests, to act according to my own feelings, and not according to those of impartial spectators, I never fail to incur the punishment of remorse. When my passion is gratified, and I begin to reflect coolly on my conduct, I can no longer enter into the motives from which it proceeded ; it appears as improper to me as to the rest of the world ; I lament the effects it has produced ; I pity the unhappy sufferer whom I have injured ; and I feel myself a just object of indignation to mankind. " Such, says Mr SMITH, is the nature of that sentiment which is properly called remorse. It is made up of shame from the sense of the impropriety of past conduct ; of grief for the effects of it ; of pity for those who suffer by it ; and of the dread and terror of punishment from the consciousness of the justly provoked resentment of all rational creatures."

THE opposite behaviour of him who, from proper motives, has performed a generous action, inspires, in a similar manner, the opposite sentiment of conscious merit, or of deserved reward.

THE foregoing observations contain a general summary of Mr SMITH's principles with respect to the origin of our moral sentiments, in so far at least as they relate to the conduct of others. He acknowledges, at the same time, that the sentiments of which we are conscious, on particular occasions, do not always coincide with these principles ; and that they are frequently modified by other considerations very different from the propriety or impropriety of the affections of the agent, and also from the beneficial or hurtful tendency of these affections. The good or the bad consequences which accidentally follow from an action, and which, as they do not depend on the agent, ought undoubtedly, in point of justice, to have no influence on our opinion, either of the propriety or the merit

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of his conduct, scarcely ever fail to influence considerably our judgment with respect to both ; by leading us to form a good or a bad opinion of the prudence with which the action was performed, and by animating our sense of the merit or demerit of his design. These facts, however, do not furnish any objections which are peculiarly applicable to Mr SMITH's theory ; for whatever hypothesis we may adopt with respect to the origin of our moral perceptions, all men must acknowledge, that in so far as the prosperous or the unprosperous event of an action depends on fortune or on accident, it ought neither to increase nor to diminish our moral approbation or disapprobation of the agent. And accordingly it has, in all ages of the world, been the complaint of moralists, that the actual sentiments of mankind should so often be in opposition to this equitable and indisputable maxim. In examining, therefore, this irregularity of our moral sentiments, Mr SMITH is to be considered, not as obviating an objection peculiar to his own system, but as removing a difficulty which is equally connected with every theory on the subject which has ever been proposed. So far as I know, he is the first philosopher who has been fully aware of the importance of the difficulty, and he has indeed treated it with great ability and success. The explanation which he gives of it is not warped in the least by any peculiarity in his own scheme ; and, I must own, it appears to me to be the most solid and valuable improvement he has made in this branch of science. It is impossible to give any abstract of it in a sketch of this kind ; and therefore I must content myself with remarking, that it consists of three parts. The first explains the causes of this irregularity of sentiment ; the second, the extent of its influence ; and the third, the important purposes to which it is subservient. His remarks on the last of these heads are more particularly ingenious and pleasing ; as their object is to shew, in opposition to what we should be disposed at first to apprehend, that when nature im-

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planted the seeds of this irregularity in the human breast, her leading intention was, to promote the happiness and perfection of the species.

THE remaining part of Mr SMITH's theory is employed in shewing, in what manner *our sense of duty* comes to be formed, in consequence of an application to ourselves of the judgments we have previously passed on the conduct of others.

In entering upon this enquiry, which is undoubtedly the most important in the work, and for which the foregoing speculations are, according to Mr SMITH's theory, a necessary preparation, he begins with stating *the fact* concerning our consciousness of merited praise or blame; and it must be owned, that the first aspect of the fact, as he himself states it, appears not very favourable to his principles. That the great object of a wise and virtuous man is not to act in such a manner as to obtain the actual approbation of those around him, but to act so as to render himself the *just*, and *proper* object of their approbation, and that his satisfaction with his own conduct depends much more on the consciousness of deserving this approbation than from that of really enjoying it, he candidly acknowledges; but still he insists, that although this may seem, at first view, to intimate the existence of some moral faculty which is not borrowed from without, our moral sentiments have always some secret reference, either to what are, or to what upon a certain condition would be, or to what we imagine ought to be, the sentiments of others; and that if it were possible, that a human creature could grow up to manhood without any communication with his own species, he could no more think of his own character, or of the propriety or demerit of his own sentiments and conduct, than of the beauty or deformity of his own face. There is indeed a tribunal within the breast, which is the supreme arbiter of all our actions, and

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which often mortifies us amidst the applause, and supports us under the censure of the world; yet still, he contends, that if we enquire into the origin of its institution, we shall find, that its jurisdiction is, in a great measure, derived from the authority of that very tribunal whose decisions it so often and so justly reverses.

WHEN we first come into the world, we, for some time, fondly pursue the impossible project of gaining the good-will and approbation of every body. We soon however find, that this universal approbation is unattainable; that the most equitable conduct must frequently thwart the interests or the inclinations of particular persons, who will seldom have candour enough to enter into the propriety of our motives, or to see that this conduct, how disagreeable soever to them, is perfectly suitable to our situation. In order to defend ourselves from such partial judgments, we soon learn to set up in our own minds, a judge between ourselves and those we live with. We conceive ourselves as acting in the presence of a person, who has no particular relation, either to ourselves, or to those whose interests are affected by our conduct; and we study to act in such a manner as to obtain the approbation of this supposed impartial spectator. It is only by consulting him, that we can see whatever relates to ourselves in its proper shape and dimensions.

THESE are two different occasions, on which we examine our own conduct, and endeavour to view it in the light in which the impartial spectator would view it. First, when we are about to act; and, secondly, after we have acted. In both cases, our views are very apt to be partial.

WHEN we are about to act, the eagerness of passion seldom allows us to consider what we are doing with the candour of an indifferent person. When the action is over, and the passions which prompted it have subsided, although we can undoubtedly enter into the sentiments of the indifferent spectator much

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much more coolly than before, yet it is so disagreeable to us to think ill of ourselves, that we often purposely turn away our view from those circumstances which might render our judgment unfavourable.—Hence that self-deceit which is the source of half the disorders of human life.

IN order to guard ourselves against its delusions, nature leads us to form insensibly, by our continual observations upon the conduct of others, certain general rules concerning what is fit and proper either to be done or avoided. Some of their actions shock all our natural sentiments; and when we observe other people affected in the same manner with ourselves, we are confirmed in the belief, that our disapprobation was just. We naturally therefore lay it down as a general rule, that all such actions are to be avoided, as tending to render us odious, contemptible or punishable; and we endeavour, by habitual reflection, to fix this general rule in our minds, in order to correct the misrepresentations of self-love, if we should ever be called on to act in similar circumstances. The man of furious resentment, if he was to listen to the dictates of that passion, would perhaps regard the death of his enemy as but a small compensation for a trifling wrong. But his observations on the conduct of others have taught him how horrible such sanguinary revenges are; and he has impressed it on his mind as an invariable rule, to abstain from them upon all occasions. This rule preserves its authority with him, checks the impetuosity of his passion, and corrects the partial views which self-love suggests; although, if this had been the first time in which he considered such an action, he would undoubtedly have determined it to be just and proper, and what every impartial spectator would approve of.—A regard to such general rules of morality constitutes, according to MR SMITH, what is properly called *the sense of duty*.

I BEFORE hinted, that MR SMITH does not reject entirely from his system that principle of *utility*, of which the perception

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tion in any action or character constitutes, according to Mr HUME, the sentiment of moral approbation. That no qualities of the mind are approved of as virtuous, but such as are useful or agreeable, either to the person himself or to others, he admits to be a proposition that holds universally; and he also admits, that the sentiment of approbation with which we regard virtue, is enlivened by the perception of this utility, or, as he explains the fact, it is enlivened by our sympathy with the happiness of those to whom the utility extends: But still he insists, that it is not the view of this utility which is either the first or principal source of moral approbation.

To sum up the whole of his doctrine in a few words. "When we approve of any character or action, the sentiments which we feel are derived from four different sources. First, we sympathize with the motives of the agent; secondly, we enter into the gratitude of those who receive the benefit of his actions; thirdly, we observe that his conduct has been agreeable to the general rules by which those two sympathies generally act; and, lastly, when we consider such actions as making a part of a system of behaviour which tends to promote the happiness, either of the individual or of society, they appear to derive a beauty from this utility, not unlike that which we ascribe to any well-contrived machine." These different sentiments, he thinks, exhaust completely, in every instance that can be supposed, the compounded sentiment of moral approbation. "After deducting, says he, in any one particular case, all that must be acknowledged to proceed from some one or other of these four principles, I should be glad to know what remains; and I shall freely allow this overplus to be ascribed to a moral sense, or to any other peculiar faculty, provided any body will ascertain precisely what this overplus is."

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Mr SMITH's opinion concerning the nature of Virtue, is involved in his Theory concerning the principle of moral approbation. The idea of virtue, he thinks, always implies the idea of propriety, or of the suitableness of the affection to the object which excites it; which suitableness, according to him, can be determined in no other way than by the sympathy of impartial spectators with the motives of the agent. But still he apprehends, that this description of virtue is incomplete; for although in every virtuous action propriety is an essential ingredient, it is not always the sole ingredient. Beneficent actions have in them another quality, by which they appear, not only to deserve approbation, but recompense, and excite a superior degree of esteem, arising from a double sympathy with the motives of the agent, and the gratitude of those who are the objects of his affection. In this respect, beneficence appears to him to be distinguished from the inferior virtues of prudence, vigilance, circumspection, temperance, constancy, firmness, which are always regarded with approbation, but which confer no merit. This distinction, he apprehends, has not been sufficiently attended to by moralists; the principles of some affording no explanation of the approbation we bestow on the inferior virtues; and those of others accounting as imperfectly for the peculiar excellency which the supreme virtue of beneficence is acknowledged to possess.

SUCH are the outlines of Mr SMITH's Theory of Moral Sentiments; a work which, whatever opinion we may entertain of the justness of its conclusions, must be allowed by all to be a singular effort of invention, ingenuity and subtlety. For my own part, I must confess, that it does not coincide with my notions concerning the foundation of Morals; but I am convinced, at the same time, that it contains a large mixture of important truth, and that, although the author has sometimes been misled by too great a desire of generalizing his principles, he has had

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the merit of directing the attention of philosophers to a view of human nature which had formerly, in a great measure, escaped their notice. Of the great proportion of just and sound reasoning which the theory involves, its striking plausibility is a sufficient proof; for as the author himself has remarked, no system in morals can well gain our assent, if it does not border, in some respects, upon the truth. "A system of natural philosophy, (he observes), may appear very plausible, and be for a long time very generally received in the world, and yet have no foundation in nature; but the author who should assign as the cause of any natural sentiment, some principle which neither had any connection with it, nor resembled any other principle which had some such connection, would appear absurd and ridiculous to the most injudicious and unexperienced reader." The merit, however, of Mr SMITH's performance does not rest here. No work, undoubtedly, can be mentioned, ancient or modern, which exhibits so complete a view of those facts with respect to our moral perceptions, which it is one great object of this branch of science to refer to their general laws; and upon this account, it well deserves the careful study of all whose taste leads them to prosecute similar enquiries. These facts are indeed frequently expressed in a language which involves the author's peculiar theories: But they are always presented in the most happy and beautiful lights; and it is easy for an attentive reader, by stripping them of hypothetical terms, to state them to himself with that logical precision, which, in such very difficult disquisitions, can alone conduct us with certainty to the truth.

IT is proper to observe farther, that with the theoretical doctrines of the book, there are every where interwoven, with singular taste and address, the purest and most elevated maxims concerning the practical conduct of life; and that it abounds throughout with interesting and instructive delineations of characters and manners. A considerable part of it too is employed

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in collateral enquiries, which, upon every hypothesis that can be formed concerning the foundation of morals, are of equal importance. Of this kind is the speculation formerly mentioned, with respect to the influence of fortune on our moral sentiments, and another speculation, no less valuable, with respect to the influence of custom and fashion on the same part of our constitution.

THE style in which MR SMITH has conveyed the fundamental principles on which his theory rests, does not seem to me to be so perfectly suited to the subject as that which he employs on most other occasions. In communicating ideas which are extremely abstract and subtle, and about which it is hardly possible to reason correctly, without the scrupulous use of appropriated terms, he sometimes presents to us a choice of words, by no means strictly synonymous, so as to divert the attention from a precise and steady conception of his proposition; and a similar effect is, in other instances, produced by that diversity of forms which, in the course of his copious and seducing composition, the same truth insensibly assumes. When the subject of his work leads him to address the imagination and the heart; the variety and felicity of his illustrations; the richness and fluency of his eloquence; and the skill with which he wins the attention and commands the passions of his readers, leave him, among our English moralists, without a rival.

THE Dissertation on the Origin of Languages, which now forms a part of the same volume with the Theory of Moral Sentiments, was, I believe, first annexed to the second edition of that work. It is an essay of great ingenuity, and on which the author himself set a high value; but, in a general review

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of his publications, it deserves our attention less, on account of the opinions it contains, than as a specimen of a particular sort of enquiry, which, so far as I know, is entirely of modern origin, and which seems, in a peculiar degree, to have interested Mr SMITH's curiosity. Something very similar to it may be traced in all his different works, whether moral, political, or literary; and on all these subjects he has exemplified it with the happiest success.

WHEN, in such a period of society as that in which we live, we compare our intellectual acquirements, our opinions, manners, and institutions, with those which prevail among rude tribes, it cannot fail to occur to us as an interesting question, by what gradual steps the transition has been made from the first simple efforts of uncultivated nature, to a state of things so wonderfully artificial and complicated. Whence has arisen that systematical beauty which we admire in the structure of a cultivated language; that analogy which runs through the texture of languages spoken by the most remote and unconnected nations; and those peculiarities by which they are all distinguished from each other? Whence the origin of the different sciences and of the different arts; and by what chain has the mind been led from their first rudiments to their last and most refined improvements? Whence the astonishing fabric of the political union; the fundamental principles which are common to all governments; and the different forms which civilized society has assumed in different ages of the world? On most of these subjects very little information is to be expected from history; for long before that stage of society when men begin to think of recording their transactions, many of the most important steps of their progress have been made. A few insulated facts may perhaps be collected from the casual observations of travellers, who have viewed the arrangements of rude nations; but nothing, it is evident, can be obtained in this way,

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which approaches to a regular and connected detail of human improvement.

IN this want of direct evidence, we are under a necessity of supplying the place of fact by conjecture; and when we are unable to ascertain how men have actually conducted themselves upon particular occasions, of considering in what manner they are likely to have proceeded, from the principles of their nature, and the circumstances of their external situation. In such enquiries, the detached facts which travels and voyages afford us, may frequently serve as landmarks to our speculations; and sometimes our conclusions *a priori*, may tend to confirm the credibility of facts, which, on a superficial view, appeared to be doubtful or incredible.

NOR are such theoretical views of human affairs subservient merely to the gratification of curiosity. In examining the history of mankind, as well as in examining the phenomena of the material world, when we cannot trace the process by which an event *has been* produced, it is often of importance to be able to shew how it *may have been* produced by natural causes. Thus, in the instance which has suggested these remarks, although it is impossible to determine with certainty what the steps were by which any particular language was formed, yet if we can shew, from the known principles of human nature, how all its various parts might gradually have arisen, the mind is not only to a certain degree satisfied, but a check is given to that indolent philosophy, which refers to a miracle, whatever appearances, both in the natural and moral worlds, it is unable to explain.

To this species of philosophical investigation, which has no appropriated name in our language, I shall take the liberty of giving the title of *Theoretical or Conjectural History*; an expression which coincides pretty nearly in its meaning with that of *Natural History*, as employed by Mr HUME*, and with what some French writers have called *Histoire Raisonnée*.

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* See his *Natural History of Religion*.

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THE mathematical sciences, both pure and mixed, afford, in many of their branches, very favourable subjects for theoretical history; and a very competent judge, the late M. d'ALEMBERT, has recommended this arrangement of their elementary principles, which is founded on the natural succession of inventions and discoveries, as the best adapted for interesting the curiosity and exercising the genius of students. The same author points out as a model a passage in MONTUCLA's History of Mathematics, where an attempt is made to exhibit the gradual progress of philosophical speculation, from the first conclusions suggested by a general survey of the heavens, to the doctrines of COPERNICUS. It is somewhat remarkable, that a theoretical history of this very science, (in which we have, perhaps, a better opportunity than in any other instance whatever, of comparing the natural advances of the mind with the actual succession of hypothetical systems), was one of Mr SMITH's earliest compositions, and is one of the very small number of his manuscripts which he did not destroy before his death.

I ALREADY hinted, that enquiries perfectly analogous to these may be applied to the modes of government, and to the municipal institutions which have obtained among different nations. It is but lately, however, that these important subjects have been considered in this point of view; the greater part of politicians before the time of MONTESQUIEU, having contented themselves with an historical statement of facts, and with a vague reference of laws to the wisdom of particular legislators, or to accidental circumstances, which it is now impossible to ascertain. MONTESQUIEU, on the contrary, considered laws as originating chiefly from the circumstances of society; and attempted to account, from the changes in the condition of mankind, which take place in the different stages of their progress, for the corresponding alterations which their institutions undergo.

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dergo. It is thus, that in his occasional elucidations of the Roman jurisprudence, instead of bewildering himself among the erudition of scholiasts and of antiquaries, we frequently find him borrowing his lights from the most remote and unconnected quarters of the globe, and combining the casual observations of illiterate travellers and navigators, into a philosophical commentary on the history of law and of manners.

THE advances made in this line of enquiry since MONTESQUIEU's time have been great. Lord KAMES, in his Historical Law Tracts, has given some excellent specimens of it, particularly in his Essays on the History of Property and of Criminal Law, and many ingenious speculations of the same kind occur in the works of MR MILLAR.

IN MR SMITH's writings, whatever be the nature of his subject, he seldom misses an opportunity of indulging his curiosity, in tracing from the principles of human nature, or from the circumstances of society, the origin of the opinions and the institutions which he describes. I formerly mentioned a fragment concerning the history of astronomy which he has left for publication ; and I have heard him say more than once, that he had projected, in the earlier part of his life, a history of the other sciences on the same plan. In his Wealth of Nations, various disquisitions are introduced which have a like object in view ; particularly the theoretical delineation he has given of the natural progress of opulence in a country ; and his investigation of the causes which have inverted this order in the different countries of modern Europe. His lectures on jurisprudence seem, from the account of them formerly given, to have abounded in such enquiries.

I AM informed by the same gentleman who favoured me with the account of MR SMITH's lectures at Glasgow, that he had heard him sometimes hint an intention of writing a treatise upon the Greek and Roman republics. " And after all that has been published on that subject, I am convinced, (says he), that the

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" observations of Mr SMITH would have suggested many new
" and important views concerning the internal and domestic
" circumstances of those nations, which would have displayed
" their several systems of policy, in a light much less artificial
" than that in which they have hitherto appeared."

THE same turn of thinking was frequently, in his social hours, applied to more familiar subjects ; and the fanciful theories which, without the least affectation of ingenuity, he was continually starting upon all the common topics of discourse, gave to his conversation a novelty and variety that were quite inexhaustible. Hence too the minuteness and accuracy of his knowledge on many trifling articles, which, in the course of his speculations, he had been led to consider from some new and interesting point of view ; and of which his lively and circumstantial descriptions amused his friends the more, that he seemed to be habitually inattentive, in so remarkable a degree, to what was passing around him.

I HAVE been led into these remarks by the Dissertation on the Formation of Languages, which exhibits a very beautiful specimen of theoretical history, applied to a subject equally curious and difficult. The analogy between the train of thinking from which it has taken its rise, and that which has suggested a variety of his other disquisitions, will, I hope, be a sufficient apology for the length of this digression ; more particularly, as it will enable me to simplify the account which I am to give afterwards, of his enquiries concerning political economy.

I SHALL only observe farther on this head, that when different theoretical histories are proposed by different writers, of the progress of the human mind in any one line of exertion, these theories are not always to be understood as standing in opposition to each other. If the progress delineated in all of them be plausible, it is possible at least, that they may all have been realized ; for human affairs never exhibit, in any two instances, a perfect uniformity. But whether they have been realized or no, is often a question of little consequence. In most cases,

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it is of more importance to ascertain the progress that is most simple, than the progress that is most agreeable to fact; for, paradoxical as the proposition may appear, it is certainly true, that the real progress is not always the most natural. It may have been determined by particular accidents, which are not likely again to occur, and which cannot be considered as forming any part of that general provision which nature has made for the improvement of the race.

IN order to make some amends for the length (I am afraid I may add for the tediousness) of this section, I shall subjoin to it an original letter of Mr HUME's, addressed to Mr SMITH, soon after the publication of his Theory. It is strongly marked with that easy and affectionate pleasantry which distinguished Mr HUME's epistolary correspondence, and is entitled to a place in this Memoir, on account of its connection with an important event of Mr SMITH's life, which soon after removed him into a new scene, and influenced, to a considerable degree, the subsequent course of his studies.—The letter is dated from London, 12th April 1759.

" I GIVE you thanks for the agreeable present of your Theory. WEDDERBURN and I made presents of our copies to such of our acquaintances as we thought good judges, and proper to spread the reputation of the book. I sent one to the Duke of ARGYLE, to Lord LYTTLETON, HORACE WALPOLE, SOAME JENNYNS, and BURKE, an Irish Gentleman, who wrote lately a very pretty treatise on the Sublime. MILLAR desired my permission to send one in your name to Dr WARBURTON. I have delayed writing to you till I could tell you something of the success of the book, and could prognosticate with some probability, whether it should be finally damned to oblivion, or should

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should be registered in the temple of immortality. Though it has been published only a few weeks, I think there appear already such strong symptoms, that I can almost venture to foretel its fate. It is in short this—— But I have been interrupted in my letter by a foolish impertinent visit of one who has lately come from Scotland. He tells me that the University of Glasgow intend to declare ROUET's office vacant, upon his going abroad with Lord HOPE. I question not but you will have our friend FERGUSON in your eye, in case another project for procuring him a place in the University of Edinburgh should fail. FERGUSON has very much polished and improved his treatise on Refinement *, and with some amendments it will make an admirable book, and discovers an elegant and a singular genius. The Epigoniad, I hope, will do; but it is somewhat up-hill work. As I doubt not but you consult the Reviews sometimes at present, you will see in the Critical Review a letter upon that poem; and I desire you to employ your conjectures in finding out the author. Let me see a sample of your skill in knowing hands by your guessing at the person. I am afraid of Lord KAMES's Law Tracts. A man might as well think of making a fine sauce by a mixture of wormwood and aloes, as an agreeable composition by joining metaphysics and Scotch law. However, the book, I believe, has merit; though few people will take the pains of diving into it. But, to return to your book, and its success in this town, I must tell you—— A plague of interruptions! I ordered myself to be denied; and yet here is one that has broke in upon me again. He is a man of letters, and we have had a good deal of literary conversation. You told me that you was curious of literary anecdotes, and therefore I shall inform you of a few that have come to my knowledge. I believe I have mentioned to you already HELVETIUS's book *de l'Esprit*. It is worth your reading,

* Published afterwards under the title of "An Essay on the History of Civil Society."

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ing, not for its philosophy, which I do not highly value, but for its agreeable composition. I had a letter from him a few days ago, wherein he tells me that my name was much oftener in the manuscript, but that the Censor of books at Paris obliged him to strike it out. VOLTAIRE has lately published a small work called *Candide, ou l'Optimisme*. I shall give you a detail of it—— But what is all this to my book? say you.—My dear Mr SMITH, have patience: Compose yourself to tranquillity: Shew yourself a philosopher in practice as well as profession: Think on the emptiness, and rashness, and futility of the common judgments of men: How little they are regulated by reason in any subject, much more in philosophical subjects, which so far exceed the comprehension of the vulgar.

— *Non si quid turbida Roma,
Elevet, accedas: examenve improbum in illa
Castiges trutina: nec te quæsiveris extra.*

A wise man's kingdom is his own breast; or, if he ever looks farther, it will only be to the judgment of a select few, who are free from prejudices, and capable of examining his work. Nothing indeed can be a stronger presumption of falsehood than the approbation of the multitude; and PHOCION, you know, always suspected himself of some blunder, when he was attended with the applause of the populace.

“ SUPPOSING, therefore, that you have duly prepared yourself for the worst by all these reflections, I proceed to tell you the melancholy news, that your book has been very unfortunate; for the public seem disposed to applaud it extremely. It was looked for by the foolish people with some impatience; and the mob of literati are beginning already to be very loud in its praises. Three Bishops called yesterday at MILLAR's shop in order to buy copies, and to ask questions about the author.

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The Bishop of PETERBOROUGH said he had passed the evening in a company where he heard it extolled above all books in the world. The Duke of ARGYLE is more decisive than he uses to be, in its favour. I suppose he either considers it as an exotic, or thinks the author will be serviceable to him in the Glasgow elections. Lord LYTTLETON says, that ROBERTSON and SMITH and BOWER are the glories of English literature. OSWALD protests he does not know whether he has reaped more instruction or entertainment from it. But you may easily judge what reliance can be put on his judgment, who has been engaged all his life in public business, and who never sees any faults in his friends. MILLAR exults and brags that two thirds of the edition are already sold, and that he is now sure of success. You see what a son of the earth that is, to value books only by the profit they bring him. In that view, I believe it may prove a very good book.

" CHARLES TOWNSEND, who passes for the cleverest fellow in England, is so taken with the performance, that he said to OSWALD he would put the Duke of Buccleugh under the Author's care, and would make it worth his while to accept of that charge. As soon as I heard this, I called on him twice, with a view of talking with him about the matter, and of convincing him of the propriety of sending that young Nobleman to Glasgow: For I could not hope, that he could offer you any terms which would tempt you to renounce your Professorship: But I missed him. Mr TOWNSEND passes for being a little uncertain in his resolutions; so perhaps you need not build much on this sally.

" IN recompence for so many mortifying things, which nothing but truth could have extorted from me, and which I could easily have multiplied to a greater number, I doubt not but you are so good a Christian as to return good for evil; and to flatter my vanity by telling me, that all the godly in Scotland

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land abuse me for my account of JOHN KNOX and the Reformation. I suppose you are glad to see my paper end, and that I am obliged to conclude with

Your Humble Servant,

DAVID HUME."

S E C T I O N , III.

*From the Publication of The Theory of Moral Sentiments, till
that of The Wealth of Nations.*

AFTER the publication of the Theory of Moral Sentiments, Mr SMITH remained four years at Glasgow, discharging his official duties with unabated vigour, and with increasing reputation. During that time, the plan of his lectures underwent a considerable change. His ethical doctrines, of which he had now published so valuable a part, occupied a much smaller portion of the course than formerly ; and accordingly, his attention was naturally directed to a more complete illustration of the principles of jurisprudence and of political œconomy.

To this last subject, his thoughts appear to have been occasionally turned from a very early period of life. It is probable, that the uninterrupted friendship he had always maintained with his old companion Mr OSWALD*, had some tendency to encourage him in prosecuting this branch of his studies ; and

* SINCE the first section was printed, I find that I have committed a slight inaccuracy in mentioning Mr OSWALD and Mr SMITH as school-fellows. The former was born in 1715 ; the latter in 1723. It appears, however, that their intimacy had commenced before Mr SMITH went to the University.

the publication of Mr HUME's political discourses in the year 1752, could not fail to confirm him in those liberal views of commercial policy which had already opened to him in the course of his own enquiries. His long residence in one of the most enlightened mercantile towns in this island, and the habits of intimacy in which he lived with the most respectable of its inhabitants, afforded him an opportunity of deriving what commercial information he stood in need of, from the best sources ; and it is a circumstance no less honourable to their liberality than to his talents, that notwithstanding the reluctance so common among men of business to listen to the conclusions of mere speculation, and the direct opposition of his leading principles to all the old maxims of trade, he was able, before he quitted his situation in the University, to rank some very eminent merchants in the number of his proselytes *.

AMONG the students who attended his lectures, and whose minds were not previously warped by prejudice, the progress of his opinions, it may be reasonably supposed, was much more rapid. It was this class of his friends accordingly that first adopted his system with eagerness, and diffused a knowledge of its fundamental principles over this part of the kingdom.

TOWARDS the end of 1763, Mr SMITH received an invitation from Mr CHARLES TOWNSEND to accompany the Duke of BUCCLEUGH on his travels ; and the liberal terms in which the proposal was made to him, added to the strong desire he had felt of visiting the Continent of Europe, induced him to resign his office at Glasgow. With the connection which he was led to form in consequence of this change in his situation, he had reason to be satisfied in an uncommon degree, and he always spoke of it with pleasure and gratitude. To the public, it was not perhaps a change equally fortunate ; as it interrupted that

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* I mention this fact on the respectable authority of JAMES RITCHIE, Esq; of Glasgow.

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studious leisure for which nature seems to have destined him, and in which alone he could have hoped to accomplish those literary projects which had flattered the ambition of his youthful genius.

THE alteration, however, which, from this period, took place in his habits, was not without its advantages. He had hitherto lived chiefly within the walls of an University ; and although to a mind like his, the observation of human nature on the smallest scale is sufficient to convey a tolerably just conception of what passes on the great theatre of the world, yet it is not to be doubted, that the variety of scenes through which he afterwards passed, must have enriched his mind with many new ideas, and corrected many of those misapprehensions of life and manners which the best descriptions of them can scarcely fail to convey.—But whatever were the lights that his travels afforded to him as a student of human nature, they were probably useful in a still greater degree, in enabling him to perfect that system of political œconomy, of which he had already delivered the principles in his lectures at Glasgow, and which it was now the leading object of his studies to prepare for the public. The coincidence between some of these principles and the distinguishing tenets of the French Oeconomists, who were at that very time in the height of their reputation, and the intimacy in which he lived with some of the leaders of that sect, could not fail to assist him in methodizing and digesting his speculations ; while the valuable collection of facts, accumulated by the zealous industry of their numerous adherents, furnished him with ample materials for illustrating and confirming his theoretical conclusions.

AFTER leaving Glasgow, Mr SMITH joined the Duke of Buccleugh at London early in the year 1764, and set out with him for the Continent in the month of March following. At Dover they were met by Sir JAMES MACDONALD, who accompanied them to Paris, and with whom Mr SMITH laid the foun-

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dation of a friendship, which he always mentioned with great sensibility, and of which he often lamented the short duration. The panegyrics with which the memory of this accomplished and amiable person has been honoured by so many distinguished characters in the different countries of Europe, are a proof how well fitted his talents were to command general admiration. The esteem in which his abilities and learning were held by Mr SMITH, is a testimony to his extraordinary merit of still superior value. Mr HUME, too, seems, in this instance, to have partaken of his friend's enthusiasm. " Were you and I together, (says he in a letter to Mr SMITH), we should shed tears at present for the death of poor Sir JAMES MACDONALD. We could not possibly have suffered a greater loss than in that valuable young man."

IN this first visit to Paris, the Duke of BUCCLEUGH and Mr SMITH employed only ten or twelve days *, after which they proceeded

* THE day after his arrival at Paris, Mr SMITH sent a formal resignation of his Professorship to the Rector of the University of Glasgow. " I never was more anxious (lays he in the conclusion of this letter) for the good of the College, than at this moment; and I sincerely wish, that whoever is my successor may not only do credit to the office by his abilities, but be a comfort to the very excellent men with whom he is likely to spend his life, by the probity of his heart, and the goodness of his temper."

THE following extract from the records of the University, which follows immediately after Mr SMITH's letter of resignation, is at once a testimony to his affiduity as a Professor, and a proof of the just sense which that learned body entertained of the talents and worth of the colleague they had lost.

" THE Meeting accept of Dr SMITH's resignation, in terms of the above letter, and the office of Professor of Moral Philosophy in this University is therefore hereby declared to be vacant. The University, at the same time, cannot help expressing their sincere regret at the removal of Dr SMITH, whose distinguished probity and amiable qualities procured him the esteem and affection of his colleagues; and whose uncommon genius, great abilities, and extensive learning, did so much honour to this society; his elegant and ingenious Theory of Moral Sentiments having recommended him to the esteem of men of taste and literature throughout

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proceeded to Thoulouse, where they fixed their residence for eighteen months; and where, in addition to the pleasure of an agreeable society, Mr SMITH had an opportunity of correcting and extending his information concerning the internal policy of France, by the intimacy in which he lived with some of the principal persons of the Parliament.

FROM Thoulouse they went, by a pretty extensive tour, through the south of France to Geneva. Here they passed two months. The late Earl STANHOPE, for whose learning and worth Mr SMITH entertained a sincere respect, was then an inhabitant of that republic.

ABOUT Christmas 1765, they returned to Paris, and remained there till October following. The society in which Mr SMITH spent these ten months, may be conceived from the advantages he enjoyed, in consequence of the recommendations of Mr HUME. TURGOT, QUESNAI, NECKER, d'ALEMBERT, HELVETIUS, MARMONTEL, Madame RICCOBONI, were among the number of his acquaintances; and some of them he continued ever afterwards to reckon among his friends. From Madame d'ANVILLE, the respectable mother of the late excellent and much lamented Duke of ROCHEFOUCAULD *, he received many attentions, which he always recollects with particular gratitude.

IT is much to be regretted, that he preserved no journal of this very interesting period of his history; and such was his

aversion to committing his thoughts to paper, that he left no manuscript of his travels.

" throughout Europe. His happy talent in illustrating abstracted subjects, and " faithful assiduity in communicating useful knowledge, distinguished him as a Professor, and at once afforded the greatest pleasure and the most important instruction " to the youth under his care."

* THE following letter, which has been very accidentally preserved, while it serves as a memorial of Mr SMITH's connection with the family of ROCHEFOUCAULD, is so expressive of the virtuous and liberal mind of the writer, that I am persuaded it will give pleasure to the Society to record it in their Transactions.

" Paris,

aversion to write letters, that I scarcely suppose any memorial of it exists in his correspondence with his friends. The extent and accuracy of his memory, in which he was equalled by few,

made

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"Paris, 3. Mars 1778.

" LE desir de se rappeler à votre souvenir, Monsieur, quand on a eu l'honneur de vous connoître, doit vous paroître fort naturel; permettez que nous faisions pour cela, ma Mère et moi, l'occasion d'une édition nouvelle des *Maximes de la Rochefoucauld*, dont nous prenons la liberté de vous offrir un exemplaire. Vous voyez que nous n'avons point de rancune, puisque le mal que vous avez dit de lui dans la *Théorie des Sentimens Moraux*, ne nous empêche point de vous envoyer ce même ouvrage. Il s'en est même fallu de peu que je ne fisse encore plus, car j'avois eu peut-être la témérité d'entreprendre une traduction de votre *Théorie*; mais comme je venois de terminer la première partie, j'ai vu paroître la traduction de M. l'Abbé BLAVET, et j'ai été forcé de renoncer au plaisir que j'aurois eu de faire passer dans ma langue un des meilleurs ouvrages de la vôtre.

" IL auroit bien fallu pour lors entreprendre une justification de mon grandpère. Peut-être n'avoit-il pas été difficile, premierement de l'excuser, en disant, qu'il avoit toujours vu les hommes à la Cour, et dans la guerre civile, deux théâtres sur lesquels ils sont certainement plus mauvais qu'ailleurs; et ensuite de justifier par la conduite personnelle de l'auteur, les principes qui sont certainement trop généralisés dans son ouvrage. Il a pris la partie pour le tout; et parceque les gens qu'il avoit eu le plus sous les yeux étoient animés par l'amour propre, il en a fait le mobile général de tous les hommes. Au reste, quoique son ouvrage mérite à certains égards d'être combattu, il est cependant estimable même pour le fond, et beaucoup pour la forme.

" PERMETTEZ moi de vous demander, si nous aurons bientôt une édition complète des œuvres de votre illustre ami M. HUME? Nous l'avons sincèrement regretté.

" RECEVEZ, je vous supplie, l'expression sincère de tous les sentimens d'estime et d'attachement avec lesquels j'ai l'honneur d'être, Monsieur, votre très humble et très obeissant serviteur,

Le DUC de la ROCHEFOUCAULD."

Mr SMITH's last intercourse with this excellent man was in the year 1789, when he informed him by means of a friend who happened to be then at Paris, that in the future editions of his *Theory* the name of ROCHEFOUCAULD should be no longer.

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made it of little consequence to himself to record in writing what he heard or saw ; and from his anxiety before his death to destroy all the papers in his possession, he seems to have wished, that no materials should remain for his biographers, but what were furnished by the lasting monuments of his genius, and the exemplary worth of his private life.

THE satisfaction he enjoyed in the conversation of TURGOT may be easily imagined. Their opinions on the most essential points of political œconomy were the same ; and they were both animated by the same zeal for the best interests of mankind. The favourite studies, too, of both had directed their enquiries to subjects on which the understandings of the ablest and the best informed are liable to be warped, to a great degree, by prejudice and passion ; and on which, of consequence, a coincidence of judgment is peculiarly gratifying. We are told by one of the biographers of TURGOT, that after his retreat from the ministry, he occupied his leisure in a philosophical correspondence with some of his old friends ; and, in particular, that various letters on important subjects passed between him and MR SMITH. I take notice of this anecdote chiefly as a proof of the intimacy which was understood to have subsisted between them ; for, in other respects, the anecdote seems to me to be somewhat doubtful. It is scarcely to be supposed, that MR SMITH would destroy the letters of such a correspondent as TURGOT ; and still less probable, that such an intercourse was carried on between them without the knowledge of any of MR SMITH's friends. From some enquiries that have been made at Paris by a gentleman

longer classed with that of MANDEVILLE. In the enlarged edition accordingly of that work, published a short time before his death, he has suppressed his censure of the author of the *Maximes* ; who seems indeed (however exceptionable many of his principles may be) to have been actuated, both in his life and writings, by motives very different from those of MANDEVILLE. The real scope of these maxims is placed, I think, in a just light by the ingenious author of the *notice* prefixed to the edition of them published at Paris in 1778.

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man of this Society since Mr SMITH's death, I have reason to believe, that no evidence of the correspondence exists among the papers of M. TURGOT, and that the whole story has taken its rise from a report suggested by the knowledge of their former intimacy. This circumstance I think it of importance to mention, because a good deal of curiosity has been excited by the passage in question, with respect to the fate of the supposed letters.

Mr SMITH was also well known to M. QUESNAI, the profound and original author of the Oeconomical Table; a man (according to Mr SMITH's account of him) "of the greatest "modesty and simplicity;" and whose system of political œconomy he has pronounced, "with all its imperfections," to be "the nearest approximation to the truth that has yet been published on the principles of that very important science." If he had not been prevented by QUESNAI's death, Mr SMITH had once an intention (as he told me himself) to have inscribed to him his "Wealth of Nations."

IT was not, however, merely the distinguished men who about this period fixed so splendid an æra in the literary history of France, that excited Mr SMITH's curiosity while he remained in Paris. His acquaintance with the polite literature both of ancient and modern times was extensive; and amidst his various other occupations, he had never neglected to cultivate a taste for the fine arts;—less, it is probable, with a view to the peculiar enjoyments they convey, (though he was by no means without sensibility to their beauties), than on account of their connection with the general principles of the human mind; to an examination of which they afford the most pleasing of all avenues. To those who speculate on this very delicate subject, a comparison of the modes of taste that prevail among different nations, affords a valuable collection of facts; and Mr SMITH, who was always disposed to ascribe to custom and fashion their full share in regulating the opinions of mankind

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kind with respect to beauty, may naturally be supposed to have availed himself of every opportunity which a foreign country afforded him of illustrating his former theories.

SOME of his peculiar notions, too, with respect to the imitative arts, seem to have been much confirmed by his observations while abroad. In accounting for the pleasure we receive from these arts, it had early occurred to him as a fundamental principle, that a very great part of it arises from the difficulty of the imitation ; a principle which was probably suggested to him by that of the *difficulté surmontée*, by which some French critics had attempted to explain the effect of verification and of rhyme *. This principle MR SMITH pushed to the greatest possible length, and referred to it, with singular ingenuity, a great variety of phenomena in all the different fine arts. It led him, however, to some conclusions, which appear, at first view at least, not a little paradoxical ; and I cannot help thinking, that it warped his judgment in many of the opinions which he was accustomed to give on the subject of poetry.

THE principles of dramatic composition had more particularly attracted his attention ; and the history of the theatre, both in ancient and modern times, had furnished him with some of the most remarkable facts on which his theory of the imitative arts was founded. From this theory it seemed to follow as a consequence, that the same circumstances which, in tragedy, give to blank verse an advantage over prose, should give to rhyme an advantage over blank verse ; and MR SMITH had always inclined to that opinion. Nay, he had gone so far as to extend the same doctrine to comedy ; and to regret, that those excellent pictures of life and manners which the English stage affords, had not been executed after the model of the French school. The admiration with which he regarded the great dramatic authors of France tended to confirm him in these opinions ;

* See the Preface to VOLTAIRE's *Oedipe*, Edit. of 1729.

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nions ; and this admiration (resulting originally from the general character of his taste, which delighted more to remark that pliancy of genius which accommodates itself to established rules, than to wonder at the bolder flights of an undisciplined imagination) was increased to a great degree, when he saw the beauties that had struck him in the closet, heightened by the utmost perfection of theatrical exhibition. In the last years of his life, he sometimes amused himself, at a leisure hour, in supporting his theoretical conclusions on these subjects, by the facts which his subsequent studies and observations had suggested ; and he intended, if he had lived, to have prepared the result of these labours for the press. Of this work he has left for publication a short fragment ; the first part of which is, in my judgment, more finished in point of style than any of his compositions ; but he had not proceeded far enough to apply his doctrine to versification and to the theatre. As his notions, however, with respect to these were a favourite topic of his conversation, and were intimately connected with his general principles of criticism, it would have been improper to pass them over in this sketch of his life ; and I even thought it proper to detail them at greater length than the comparative importance of the subject would have justified, if he had carried his plans into execution. Whether his love of system, added to his partiality for the French drama, may not have led him, in this instance, to generalize a little too much his conclusions, and to overlook some peculiarities in the language and versification of that country, I shall not take upon me to determine.

IN October 1766, the Duke of Buccleugh returned to London. His Grace, to whom I am indebted for several particulars in the foregoing narrative, will, I hope, forgive the liberty I take in transcribing one paragraph in his own words : " In " October 1766, we returned to London, after having spent " near three years together, without the slightest disagreement
" or

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" or coolness ;—on my part, with every advantage that could be expected from the society of such a man. We continued to live in friendship till the hour of his death ; and I shall always remain with the impression of having lost a friend whom I loved and respected, not only for his great talents, but for every private virtue."

THE retirement in which MR SMITH passed his next ten years, formed a striking contrast to the unsettled mode of life he had been for some time accustomed to, but was so congenial to his natural disposition, and to his first habits, that it was with the utmost difficulty he was ever persuaded to leave it. During the whole of this period, (with the exception of a few visits to Edinburgh and London), he remained with his mother at Kirkaldy ; occupied habitually in intense study, but unbending his mind at times in the company of some of his old school-fellows, whose " sober wishes" had attached them to the place of their birth. In the society of such men, MR SMITH delighted ; and to them he was endeared, not only by his simple and unassuming manners, but by the perfect knowledge they all possessed of those domestic virtues which had distinguished him from his infancy.

MR HUME, who (as he tells us himself) considered " a town as the true scene for a man of letters," made many attempts to seduce him from his retirement. In a letter, dated in 1772, he urges him to pass some time with him in Edinburgh. " I shall not take any excuse from your state of health, which I suppose only a subterfuge invented by indolence and love of solitude. Indeed, my dear SMITH, if you continue to hearken to complaints of this nature, you will cut yourself out entirely from human society, to the great loss of both parties." In another letter, dated in 1769, from his house in James's Court, (which commanded a prospect of the frith of Forth, and of the opposite coast of Fife), " I am glad (says he) to have come within sight of you ; but as I would also be with-
" in

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" in speaking terms of you, I wish we could concert measures
" for that purpose. I am mortally sick at sea, and regard with
" horror and a kind of hydrophobia the great gulph that lies
" between us. I am also tired of travelling, as much as you
" ought naturally to be of staying at home. I therefore pro-
" pose to you to come hither, and pass some days with me in
" this solitude. I want to know what you have been doing,
" and propose to exact a rigorous account of the method in
" which you have employed yourself during your retreat. I
" am positive you are in the wrong in many of your specula-
" tions, especially where you have the misfortune to differ from
" me. All these are reasons for our meeting, and I wish you
" would make me some reasonable proposal for that purpose.
" There is no habitation on the island of Inchkeith, otherwise
" I should challenge you to meet me on that spot, and neither
" of us ever to leave the place, till we were fully agreed on all
" points of controversy. I expect General CONWAY here to-
" morrow, whom I shall attend to Roseneath, and I shall re-
" main there a few days. On my return, I hope to find a
" letter from you, containing a bold acceptance of this de-
" fiance."

AT length (in the beginning of the year 1776) Mr SMITH accounted to the world for his long retreat, by the publication of his "Inquiry into the Nature and Causes of the Wealth of Nations." A letter of congratulation on this event, from Mr HUME, is now before me. It is dated 1st April 1776, (about six months before Mr HUME's death); and discovers an amiable solicitude about his friend's literary fame. "Euge! Belle!
" Dear Mr SMITH: I am much pleased with your perform-
" ance, and the perusal of it has taken me from a state of
" great anxiety. It was a work of so much expectation, by
" yourself, by your friends, and by the public, that I trembled
" for its appearance; but am now much relieved. Not but
" that the reading of it necessarily requires so much attention,
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" and the public is disposed to give so little, that I shall still doubt for some time of its being at first very popular. But it has depth and solidity and acuteness, and is so much illustrated by curious facts, that it must at last take the public attention. It is probably much improved by your last abode in London. If you were here at my fire-side, I should dispute some of your principles. But these, and a hundred other points, are fit only to be discussed in conversation. I hope it will be soon; for I am in a very bad state of health, and cannot afford a long delay."

Of a book which is now so universally known as "The Wealth of Nations," it might be considered perhaps as superfluous to give a particular analysis; and at any rate, the limits of this essay make it impossible for me to attempt it at present. A few remarks, however, on the object and tendency of the work may, I hope, be introduced without impropriety. The history of a Philosopher's life can contain little more than the history of his speculations; and in the case of such an author as Mr SMITH, whose studies were systematically directed from his youth to subjects of the last importance to human happiness, a review of his writings, while it serves to illustrate the peculiarities of his genius, affords the most faithful picture of his character as a man.

SECTION

SECTION IV.

Of The Inquiry into the Nature and Causes of the Wealth of Nations *.Account of
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A N historical review of the different forms under which human affairs have appeared in different ages and nations, naturally suggests the question, Whether the experience of former times may not now furnish some general principles to enlighten and direct the policy of future legislators? The discussion, however, to which this question leads is of singular difficulty; as it requires an accurate analysis of by far the most complicated class of phenomena that can possibly engage our attention, those which result from the intricate and often the imperceptible mechanism of political society;—a subject of observation which seems, at first view, so little commensurate to our faculties, that it has been generally regarded with the same passive emotions of wonder and submission, with which, in the material world, we survey the effects produced, by the mysterious and uncontrollable operation of physical causes. It is fortunate that upon this, as on many other occasions, the difficulties which had long baffled the efforts of solitary genius begin to appear less formidable to the united exertions of the race; and that in proportion as the experience and the reasonings of different individuals are brought to bear upon the same objects, and are combined in such a manner as to illustrate and to limit each other, the science of politics assumes more and more that

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systematical

* THE length to which this Memoir has already extended, together with some other reasons which it is unnecessary to mention here, have induced me, in printing the following section, to confine myself to a much more general view of the subject than I once intended.

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systematical form which encourages and aids the labours of future enquirers.

IN prosecuting the science of politics on this plan, little assistance is to be derived from the speculations of ancient philosophers, the greater part of whom, in their political enquiries, confined their attention to a comparison of different forms of government, and to an examination of the provisions they made for perpetuating their own existence, and for extending the glory of the State. It was reserved for modern times to investigate those universal principles of justice and of expediency, which ought, under every form of government, to regulate the social order ; and of which the object is, to make as equitable a distribution as possible, among all the different members of a community, of the advantages arising from the political union.

THE invention of printing was perhaps necessary to prepare the way for these researches. In those departments of literature and of science, where genius finds within itself the materials of its labours ; in poetry, in pure geometry, and in some branches of moral philosophy ; the ancients have not only laid the foundations on which we are to build, but have left great and finished models for our imitation. But in physicks, where our progress depends on an immense collection of facts, and on a combination of the accidental lights daily struck out in the innumerable walks of observation and experiment ; and in politics, where the materials of our theories are equally scattered, and are collected and arranged with still greater difficulty, the means of communication afforded by the press have, in the course of two centuries, accelerated the progress of the human mind, far beyond what the most sanguine hopes of our predecessors could have imagined.

THE progress already made in this science, inconsiderable as it is in comparison of what may be yet expected, has been sufficient to shew, that the happiness of mankind depends, not on the

the share which the people possesses, directly or indirectly, in the enactment of laws, but on the equity and expediency of the laws that are enacted. The share which the people possesses in the government is interesting chiefly to the small number of men whose object is the attainment of political importance; but the equity and expediency of the laws are interesting to every member of the community; and more especially to those, whose personal insignificance leaves them no encouragement, but what they derive from the general spirit of the government under which they live.

IT is evident, therefore, that the most important branch of political science is that which has for its object to ascertain the philosophical principles of jurisprudence; or (as MR SMITH expresses it) to ascertain "the general principles which ought to " run through and be the foundation of the laws of all nations *." In countries, where the prejudices of the people are widely at variance with these principles, the political liberty which the constitution bestows, only furnishes them with the means of accomplishing their own ruin: And if it were possible to suppose these principles completely realized in any system of laws, the people would have little reason to complain, that they were not immediately instrumental in their enactment. The only infallible criterion of the excellence of any constitution is to be found in the detail of its municipal code; and the value which wise men set on political freedom, arises chiefly from the facility it is supposed to afford, for the introduction of those legislative improvements which the general interests of the community recommend.—I cannot help adding, that the capacity of a people to exercise political rights with utility to themselves and to their country, presupposes a diffusion of knowledge and of good morals, which can only result from the previous operation of laws favourable to industry, to order and to freedom.

Q.E.D.

* See the conclusion of his Theory of Moral Sentiments.

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OF the truth of these remarks, enlightened politicians seem now to be in general convinced ; for the most celebrated works which have been produced in the different countries of Europe, during the last thirty years, by SMITH, QUESNAI, TURGOT, CAMPOMANES, BECCARIA, and others, have aimed at the improvement of society,—not by delineating plans of new constitutions, but by enlightening the policy of actual legislators. Such speculations, while they are more essentially and more extensively useful than any others, have no tendency to unhinge established institutions, or to inflame the passions of the multitude. The improvements they recommend are to be effected by means too gradual and slow in their operation, to warm the imaginations of any but of the speculative few ; and in proportion as they are adopted, they consolidate the political fabric, and enlarge the basis upon which it rests.

To direct the policy of nations with respect to one most important class of its laws, those which form its system of political œconomy, is the great aim of Mr SMITH's *Inquiry* : And he has unquestionably had the merit of presenting to the world, the most comprehensive and perfect work that has yet appeared, on the general principles of any branch of legislation. The example which he has set will be followed, it is to be hoped, in due time, by other writers, for whom the internal policy of states furnishes many other subjects of discussion no less curious and interesting ; and may accelerate the progress of that science which Lord BACON has so well described in the following passage : “ *Finis et scopus quem leges intueri, atque ad quem iussiones et sanctiones suas dirigere debent, non aliis est, quam ut cives feliciter degant : id fiet, si pietate et religione recte instituti ; moribus honesti ; armis adversus hostes externos tuti ; legum auxilio adversus seditiones et privatas injurias muniti ; imperio et magistratibus obsequentes ; copiis et opibus locupletes et florentes fuerint.* — *Certe cognitio ista ad viros civiles proprias spectat ;* ”

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"spectat; qui optime nōrunt, quid ferat societas humana,
 "quid salus populi, quid æquitas naturalis, quid gentium mo-
 "res, quid rerumpublicarum formæ diversæ: ideoque possint
 "de legibus, ex principiis et præceptis tam æquitatis naturalis,
 "quam politices decernere. Quamobrem id nunc agatur, ut
 "fontes justitiae et utilitatis publicæ petantur, et in singulis
 "juris partibus character' quidam et idea justi exhibeatur, ad
 "quam particularium regnorum et rerumpublicarum leges
 "probare, atque inde emendationem moliri, quisque, cui hoc
 "cordi erit et curæ, possit." The enumeration contained in
 the foregoing passage, of the different objects of law, coincides
 very nearly with that given by MR SMITH in the conclusion of
 his Theory of Moral Sentiments; and the precise aim of the
 political speculations which he then announced, and of which
 he afterwards published so valuable a part in his Wealth of Na-
 tions, was to ascertain the general principles of justice and of
 expediency, which ought to guide the institutions of legislators
 on these important articles;—in the words of Lord BACON, to
 ascertain those *leges legum*, "ex quibus informatio peti possit,
 "quid in singulis legibus bene aut perperam positum aut con-
 "stitutum sit."

THE branch of legislation which MR SMITH has made choice of as the subject of his work, naturally leads me to remark a very striking contrast between the spirit of ancient and of modern policy in respect to the wealth of nations*. The great object of the former was to counteract the love of money and a taste for luxury, by positive institutions; and to maintain in the great body of the people, habits of frugality, and a severity of manners. The decline of states is uniformly ascribed by the philosophers and historians, both of Greece and Rome, to the influence of riches on national character; and the laws of LY-
 CURGUS, which, during a course of ages, banished the precious metals

* Science de la Legislation, par le Chev. FILANGIERI, Liv. i. chap. 13.

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metals from Sparta, are proposed by many of them as the most perfect model of legislation devised by human wisdom.—How opposite to this is the doctrine of modern politicians! Far from considering poverty as an advantage to a state, their great aim is to open new sources of national opulence, and to animate the activity of all classes of the people by a taste for the comforts and accommodations of life.

ONE principal cause of this difference between the spirit of ancient and of modern policy, may be found in the difference between the sources of national wealth in ancient and in modern times. In ages when commerce and manufactures were yet in their infancy, and among states constituted like most of the ancient republics, a sudden influx of riches from abroad was justly dreaded as an evil, alarming to the morals, to the industry, and to the freedom of a people. So different, however, is the case at present, that the most wealthy nations are those where the people are the most laborious, and where they enjoy the greatest degree of liberty. Nay, it was the general diffusion of wealth among the lower orders of men, which first gave birth to the spirit of independence in modern Europe, and which has produced under some of its governments, and especially under our own, a more equal diffusion of freedom and of happiness than took place under the most celebrated constitutions of antiquity.

WITHOUT this diffusion of wealth among the lower orders, the important effects resulting from the invention of printing would have been extremely limited; for a certain degree of ease and independence is necessary to inspire men with the desire of knowledge, and to afford them the leisure which is requisite for acquiring it; and it is only by the rewards which such a state of society holds up to industry and ambition, that the selfish passions of the multitude can be interested in the intellectual improvement of their children. The extensive propagation

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pagation of light and refinement arising from the influence of the press, aided by the spirit of commerce, seems to be the remedy provided by nature, against the fatal effects which would otherwise be produced, by the subdivision of labour accompanying the progress of the mechanical arts : Nor is any thing wanting to make the remedy effectual, but wise institutions to facilitate general instruction, and to adapt the education of individuals to the stations they are to occupy. The mind of the artist, which, from the limited sphere of his activity, would sink below the level of the peasant or the savage, might receive in infancy the means of intellectual enjoyment, and the seeds of moral improvement ; and even the insipid uniformity of his professional engagements, by presenting no object to awaken his ingenuity or to distract his attention, might leave him at liberty to employ his faculties, on subjects more interesting to himself, and more extensively useful to others.

THESE effects, notwithstanding a variety of opposing causes which still exist, have already resulted, in a very sensible degree, from the liberal policy of modern times. Mr HUME, in his Essay on Commerce, after taking notice of the numerous armies raised and maintained by the small republics in the ancient world, ascribes the military power of these states to their want of commerce and luxury. " Few " artisans were maintained by the labour of the farmers, and " therefore more soldiers might live upon it." He adds, however, that " the policy of ancient times was VIOLENT, and contrary to the NATURAL course of things ;" —by which, I presume, he means, that it aimed too much at modifying, by the force of positive institutions, the order of society, according to some preconceived idea of expediency ; without trifling sufficiently to those principles of the human constitution, which, wherever they are allowed free scope, not only conduct mankind to happiness, but lay the foundation of a progressive im-

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provement in their condition and in their character. The advantages which modern policy possesses over the ancient, arises principally from its conformity, in some of the most important articles of political œconomy, to an order of things recommended by nature ; and it would not be difficult to shew, that where it remains imperfect, its errors may be traced to the restraints it imposes on the natural course of human affairs. Indeed, in these restraints may be discovered the latent seeds of many of the prejudices and follies which infect modern manners, and which have so long bid defiance to the reasonings of the philosopher and the ridicule of the satirist.

THE foregoing very imperfect hints appeared to me to form, not only a proper, but in some measure a necessary introduction to the few remarks I have to offer on Mr SMITH's Inquiry; as they tend to illustrate a connection between his system of commercial politics, and those speculations of his earlier years, in which he aimed more professedly at the advancement of human improvement and happiness. It is this view of political œconomy that can alone render it interesting to the moralist, and can dignify calculations of profit and loss in the eye of the philosopher. Mr SMITH has alluded to it in various passages of his work, but he has no where explained himself fully on the subject ; and the great stress he has laid on the effects of the division of labour in increasing its productive powers seems, at first sight, to point to a different and very melancholy conclusion ;—that the same causes which promote the progress of the arts, tend to degrade the mind of the artist ; and, of consequence, that the growth of national wealth implies a sacrifice of the character of the people.

THE fundamental doctrines of Mr SMITH's system are now so generally known, that it would have been tedious to offer any recapitulation of them in this place ; even if I could have hoped to do justice to the subject, within the limits which I have prescribed

prescribed to myself at present. A distinct analysis of his work might indeed be useful to many readers; but it would itself form a volume of considerable magnitude. I may perhaps, at some future period, present to the Society, an attempt towards such an analysis, which I began long ago, for my own satisfaction, and which I lately made considerable progress in preparing for the press, before I was aware of the impossibility of connecting it, with the general plan of this paper. In the mean time, I shall content myself with remarking, that the great and leading object of Mr SMITH's speculations is to illustrate the provision made by nature in the principles of the human mind, and in the circumstances of man's external situation, for a gradual and progressive augmentation in the means of national wealth; and to demonstrate, that the most effectual plan for advancing a people to greatness, is to maintain that order of things which nature has pointed out; by allowing every man, as long as he observes the rules of justice, to pursue his own interest in his own way, and to bring both his industry and his capital into the freest competition with those of his fellow-citizens. Every system of policy which endeavours, either by extraordinary encouragements, to draw towards a particular species of industry a greater share of the capital of the society than what would naturally go to it; or, by extraordinary restraints, to force from a particular species of industry some share of the capital which would otherwise be employed in it, is, in reality, subversive of the great purpose which it means to promote.

WHAT the circumstances are, which, in modern Europe, have contributed to disturb this order of nature, and, in particular, to encourage the industry of towns, at the expence of that of the country, Mr SMITH has investigated with great ingenuity; and in such a manner, as to throw much new light on the history

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of that state of society which prevails in this quarter of the globe. His observations on this subject tend to shew, that these circumstances were, in their first origin, the natural and the unavoidable result of the peculiar situation of mankind during a certain period; and that they took their rise, not from any general scheme of policy, but from the private interests and prejudices of particular orders of men.

THE state of society, however, which at first arose from a singular combination of accidents, has been prolonged much beyond its natural period, by a false system of political economy, propagated by merchants and manufacturers; a class of individuals, whose interest is not always the same with that of the public, and whose professional knowledge gave them many advantages, more particularly in the infancy of this branch of science, in defending those opinions which they wished to encourage. By means of this system, a new set of obstacles to the progress of national prosperity has been created. Those which arose from the disorders of the feudal ages, tended directly to disturb the internal arrangements of society, by obstructing the free circulation of labour and of stock, from employment to employment, and from place to place. The false system of political economy which has been hitherto prevalent, as its professed object has been to regulate the commercial intercourse between different nations, has produced its effect in a way less direct and less manifest, but equally prejudicial to the states that have adopted it.

ON this system, as it took its rise from the prejudices, or rather from the interested views of mercantile speculators, MR SMITH bestows the title of the Commercial or Mercantile System; and he has considered at great length its two principal expedients for enriching a nation; restraints upon importation, and encouragements to exportation. Part of these expedients, he observes, have been dictated by the spirit of monopoly, and part

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by a spirit of jealousy against those countries with which the balance of trade is supposed to be disadvantageous. All of them appear clearly, from his reasonings, to have a tendency unfavourable to the wealth of the nation which imposes them.—His remarks with respect to the jealousy of commerce are expressed in a tone of indignation, which he seldom assumes in his political writings.

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" IN this manner (says he) the sneaking arts of underling tradesmen are erected into political maxims for the conduct of a great empire. By such maxims as these, nations have been taught that their interest consisted in beggaring all their neighbours. Each nation has been made to look with an inviolous eye upon the prosperity of all the nations with which it trades, and to consider their gain as its own loss. Commerce, which ought naturally to be among nations as among individuals, a bond of union and friendship, has become the most fertile source of discord and animosity. The capricious ambition of Kings and Ministers has not, during the present and the preceding century, been more fatal to the repose of Europe, than the impertinent jealousy of merchants and manufacturers. The violence and injustice of the rulers of mankind is an ancient evil, for which perhaps the nature of human affairs can scarce admit of a remedy. But the mean rapacity, the monopolizing spirit of merchants and manufacturers, who neither are nor ought to be the rulers of mankind, though it cannot perhaps be corrected, may very easily be prevented from disturbing the tranquillity of any body but themselves."

SUCH are the liberal principles which, according to MR SMITH, ought to direct the commercial policy of nations; and of which it ought to be the great object of legislators to facilitate the establishment. In what manner the execution of the theory should be conducted in particular instances, is a question of a very different

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ferent nature, and to which the answer must vary, in different countries, according to the different circumstances of the case. In a speculative work, such as Mr SMITH's, the consideration of this question did not fall properly under his general plan; but that he was abundantly aware of the danger to be apprehended from a rash application of political theories, appears, not only from the general strain of his writings, but from some incidental observations which he has expressly made upon the subject. " So unfortunate (says he, in one passage) are the " effects of all the regulations of the mercantile system, that " they not only introduce very dangerous disorders into the " state of the body politic, but disorders which it is often dif- " ficult to remedy, without occasioning, for a time at least, " still greater disorders.—In what manner, therefore, the na- " tural system of perfect liberty and justice ought gradually to " be restored, we must leave to the wisdom of future statesmen " and legislators to determine." In the last edition of his Theory of Moral Sentiments, he has introduced some remarks, which have an obvious reference to the same important doc- trine. The following passage seems to refer more particularly to those derangements of the social order which derived their origin from the feudal institutions.

" THE man whose public spirit is prompted altogether by " humanity and benevolence, will respect the established powers " and privileges even of individuals, and still more of the " great orders and societies into which the state is divided. " Though he should consider some of them as in some measure " abusive, he will content himself with moderating, what he often " cannot annihilate without great violence. When he cannot " conquer the rooted prejudices of the people by reason and " persuasion, he will not attempt to subdue them by force; " but will religiously observe what, by CICERO, is justly called " the divine maxim of PLATO, never to use violence to his
" country

" country no more than to his parents. He will accommodate,
" as well as he can, his public arrangements to the confirmed
" habits and prejudices of the people; and will remedy, as
" well as he can, the inconveniences which may flow from the
" want of those regulations which the people are averse to sub-
" mit to. When he cannot establish the right, he will not dis-
"dain to ameliorate the wrong; but, like SOLON, when he
" cannot establish the best system of laws, he will endeavour
" to establish the best that the people can bear."

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THESE cautions with respect to the practical application of general principles were peculiarly necessary from the Author of "The Wealth of Nations;" as the unlimited freedom of trade, which it is the chief aim of his work to recommend, is extremely apt, by flattering the indolence of the statesman, to suggest to those who are invested with absolute power, the idea of carrying it into immediate execution. "Nothing is more adverse to the tranquillity of a statesman (says the author of an Eloge on the Administration of COLBERT) than a spirit of moderation; because it condemns him to perpetual observation, shews him every moment the insufficiency of his wisdom, and leaves him the melancholy sense of his own imperfection; while, under the shelter of a few general principles, a systematical politician enjoys a perpetual calm. By the help of one alone, that of a perfect liberty of trade, he would govern the world, and would leave human affairs to arrange themselves at pleasure, under the operation of the prejudices and the self-interest of individuals. If these run counter to each other, he gives himself no anxiety about the consequence; he insists that the result cannot be judged of till after a century or two shall have elapsed. If his contemporaries, in consequence of the disorder into which he has thrown public affairs, are scrupulous about submitting quietly to the experiment, he accuses them of impatience. They alone,

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" alone, and not he, are to blame for what they have suffered ;
 " and the principle continues to be inculcated with the same
 " zeal and the same confidence as before." These are the
 words of the ingenious and eloquent author of the *Eloge on
COLBERT*, which obtained the prize from the French Academy
 in the year 1763 ; a performance which, although confined
 and erroneous in its speculative views, abounds with just
 and important reflections of a practical nature. How far his
 remarks apply to that particular class of politicians whom he
 had evidently in his eye in the foregoing passage, I shall not
 presume to decide.

It is hardly necessary for me to add to these observations, that they do not detract in the least from the value of those political theories which attempt to delineate the principles of a perfect legislation. Such theories (as I have elsewhere observed *) ought to be considered merely as descriptions of the *ultimate* objects at which the statesman ought to aim. The tranquillity of his administration, and the immediate success of his measures, depend on his good sense and his practical skill ; and his theoretical principles only enable him to direct his measures steadily and wisely, to promote the improvement and happiness of mankind, and prevent him from being ever led astray from these important ends, by more limited views of temporary expedience. " In
 " all cases (says Mr HUME) it must be advantageous to know
 " what is most perfect in the kind, that we may be able to
 " bring any real constitution or form of government as near it
 " as possible, by such gentle alterations and innovations as may
 " not give too great disturbance to society."

THE limits of this Memoir make it impossible for me to examine particularly the merit of Mr SMITH's work in point of originality. That his doctrine concerning the freedom of trade
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* Elements of the Philosophy of the Human Mind, p. 261.

and of industry coincides remarkably with that which we find in the writings of the French Oeconomists, appears from the slight view of their system which he himself has given. But it surely cannot be pretended by the warmest admirers of that system, that any one of its numerous expositors has approached to Mr SMITH in the precision and perspicuity with which he has stated it, or in the scientific and luminous manner in which he has deduced it from elementary principles. The awkwardness of their technical language, and the paradoxical form in which they have chosen to present some of their opinions, are acknowledged even by those who are most willing to do justice to their merits; whereas it may be doubted with respect to Mr SMITH's Inquiry, if there exists any book beyond the circle of the mathematical and physical sciences, which is at once so agreeable in its arrangement to the rules of a sound logic, and so accessible to the examination of ordinary readers. Abstracting entirely from the author's peculiar and original speculations, I do not know, that upon any subject whatever, a work has been produced in our times, containing so methodical, so comprehensive and so judicious a digest of all the most profound and enlightened philosophy of the age.

IN justice also to Mr SMITH, it must be observed, that although some of the œconomical writers had the start of him in publishing their doctrines to the world, these doctrines appear, with respect to him, to have been altogether original, and the result of his own reflections. Of this, I think, every person must be convinced, who reads the Inquiry with due attention, and is at pains to examine the gradual and beautiful progress of the author's ideas: But in case any doubt should remain on this head, it may be proper to mention, that Mr SMITH's political lectures, comprehending the fundamental principles of his Inquiry, were delivered at Glasgow as early as the year 1752 or 1753; at a period, surely, when there existed

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no French performance on the subject, that could be of much use to him in guiding his researches *. In the year 1756, indeed, M. TURGOT (who is said to have imbibed his first notions concerning the unlimited freedom of commerce from an old merchant, M. GOURNAY) published in the *Encyclopedie*, an article which sufficiently shews how completely his mind was emancipated from the old prejudices in favour of commercial regulations: But that even then, these opinions were confined to a few speculative men in France, appears from a passage in the *Mémoires sur la Vie et les Ouvrages de M. TURGOT*; in which, after a short quotation from the article just mentioned, the author adds: "These ideas were then considered as paradoxical; "they are since become common, and they will one day be "adopted universally."

THE Political Discourses of Mr HUME were evidently of greater use to Mr SMITH, than any other book that had appeared prior to his lectures. Even Mr HUME's theories, however, though always plausible and ingenious, and in most instances profound and just, involve some fundamental mistakes; and, when compared with Mr SMITH's, afford a striking proof, that, in considering a subject so extensive and so complicated, the most penetrating sagacity, if directed only to particular questions, is apt to be led astray by first appearances; and that nothing can guard us effectually against error, but a comprehensive survey of the whole field of discussion, assisted by an accurate and patient analysis of the ideas about which our reasonings are employed.—It may be worth while to add, that Mr HUME's Essay "on the Jealousy of Trade," with some other of his Political Discourses, received a very flattering proof of

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* In proof of this, it is sufficient for me to appeal to a short history of the progress of political economy in France, published in one of the volumes of *Ephemerides du Citoyen*. See the first part of the volume for the year 1769. The paper is entitled, *Notice abrégée des différents Ecrits modernes, qui ont concouru en France à former la science de l'économie politique.*

M. TURGOT's approbation, by his undertaking the task of translating them into the French language.

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I AM aware, that the evidence I have hitherto produced of Mr SMITH's originality may be objected to as not perfectly decisive, as it rests entirely on the recollection of those students who attended his first courses of moral philosophy at Glasgow; a recollection which, at the distance of forty years, cannot be supposed to be very accurate. There exists however fortunately, a short manuscript, drawn up by Mr SMITH in the year 1755, and presented by him to a society of which he was then a member; in which paper, a pretty long enumeration is given of certain leading principles, both political and literary, to which he was anxious to establish his exclusive right; in order to prevent the possibility of some rival claims which he thought he had reason to apprehend, and to which his situation as a Professor, added to his unreserved communications in private companies, rendered him peculiarly liable. This paper is at present in my possession. It is expressed with a good deal of that honest and indignant warmth, which is perhaps unavoidable by a man who is conscious of the purity of his own intentions, when he suspects, that advantages have been taken of the frankness of his temper. On such occasions, due allowances are not always made for those plagiarisms which, however cruel in their effects, do not necessarily imply bad faith in those who are guilty of them; for the bulk of mankind, incapable themselves of original thought, are perfectly unable to form a conception of the nature of the injury done to a man of inventive genius, by encroaching on a favourite speculation. For reasons known to some members of this Society, it would be improper, by the publication of this manuscript, to revive the memory of private differences; and I should not have even alluded to it, if I did not think it a valuable document of the progress of Mr SMITH's political ideas at a very early period. Many of the most im-

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portant opinions in *the Wealth of Nations* are there detailed; but I shall only quote the following sentences. "Man" is generally considered by statesmen and projectors as the "materials of a sort of political mechanics. Projectors disturb nature in the course of her operations in human affairs; and it requires no more than to let her alone, and "give her fair play in the pursuit of her ends, that she may establish her own designs."—And in another passage: "Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism, but peace, easy taxes, and "a tolerable administration of justice; all the rest being "brought about by the natural course of things. All governments which thwart this natural course, which force things "into another channel, or which endeavour to arrest the progress of society at a particular point, are unnatural, and to "support themselves are obliged to be oppressive and tyrannical.—A great part of the opinions (he observes) enumerated in this paper is treated of at length in some lectures which I have still by me, and which were written in "the hand of a clerk who left my service six years ago. They "have all of them been the constant subjects of my lectures "since I first taught Mr CRAIGIE's class, the first winter I "spent in Glasgow, down to this day, without any considerable variation. They had all of them been the subjects of lectures which I read at Edinburgh the winter "before I left it, and I can adduce innumerable witnesses, both "from that place and from this, who will ascertain them sufficiently to be mine."

AFTER all, perhaps the merit of such a work as MR SMITH's is to be estimated less from the novelty of the principles it contains, than from the reasonings employed to support these principles, and from the scientific manner in which they are unfolded in their proper order and connection. General assertions

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tions with respect to the advantages of a free commerce, may be collected from various writers of an early date. But in questions of so complicated a nature as occur in political œconomy, the credit of such opinions belongs of right to the author who first established their solidity, and followed them out to their remote consequences ; not to him who, by a fortunate accident, first stumbled on the truth.

BESIDES the principles which Mr SMITH considered as more peculiarly his own, his Inquiry exhibits a systematical view of the most important articles of political œconomy, so as to serve the purpose of an elementary treatise on that very extensive and difficult science. The skill and the comprehensiveness of mind displayed in his arrangement, can be judged of by those alone who have compared it with that adopted by his immediate predecessors. And perhaps, in point of utility, the labour he has employed in connecting and methodising their scattered ideas, is not less valuable than the results of his own original speculations : For it is only when digested in a clear and natural order, that truths make their proper impression on the mind, and that erroneous opinions can be combated with success.

IT does not belong to my present undertaking (even if I were qualified for such a task) to attempt a separation of the solid and important doctrines of Mr SMITH's book from those opinions which appear exceptionable or doubtful. I acknowledge, that there are some of his conclusions to which I would not be understood to subscribe implicitly ; more particularly in that chapter, where he treats of the principles of taxation, and which is certainly executed in a manner more loose and unsatisfactory than the other parts of his system.

IT would be improper for me to conclude this section without taking notice of the manly and dignified freedom with which the author uniformly delivers his opinions, and of the

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superiority which he discovers throughout, to all the little passions connected with the factions of the times in which he wrote. Whoever takes the trouble to compare the general tone of his composition with the period of its first publication, cannot fail to feel and acknowledge the force of this remark.— It is not often that a disinterested zeal for truth has so soon met with its just reward. Philosophers (to use an expression of Lord BACON's) are “the servants of posterity;” and most of those who have devoted their talents to the best interests of mankind, have been obliged, like BACON, to “bequeath their fame” to a race yet unborn, and to console themselves with the idea of sowing what another generation was to reap :

Infere Daphni pyros, carpent tua poma nepotes.

MR SMITH was more fortunate ; or rather, in this respect, his fortune was singular. He survived the publication of his work only fifteen years ; and yet, during that short period, he had not only the satisfaction of seeing the opposition it at first excited, gradually subside, but to witness the practical influence of his writings on the commercial policy of his country.

SECTION

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Conclusion of the Narrative.

ABOUT two years after the publication of "the Wealth of Nations," Mr SMITH was appointed one of the Commissioners of his Majesty's Customs in Scotland; a preferment which, in his estimation, derived an additional value from its being bestowed on him at the request of the Duke of BUCLEUGH. The greater part of these two years he passed at London, in a society too extensive and varied to afford him any opportunity of indulging his taste for study. His time, however, was not lost to himself; for much of it was spent with some of the first names in English literature. Of these no unfavourable specimen is preserved by DR BARNARD, in his well known "Verses, addressed to Sir JOSHUA REYNOLDS and his friends."

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If I have thoughts, and can't express 'em,
GIBBON shall teach me how to dress 'em

In words select and terse :

JONES teach me modesty and Greek,
SMITH how to think, BURKE how to speak,
And BEAUCLERC to converse *.

IN consequence of MR SMITH's appointment to the Board of Customs, he removed, in 1778, to Edinburgh, where he spent the last twelve years of his life; enjoying an affluence which was more than equal to all his wants; and, what was to him of still greater value, the prospect of passing the remainder of his days among the companions of his youth.

HIS mother, who, though now in extreme old age, still possessed a considerable degree of health, and retained all her faculties unimpaired, accompanied him to town; and his cousin

Mrs

* See Annual Register for the year 1776.

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Miss JANE DOUGLAS, (who had formerly been a member of his family at Glasgow, and for whom he had always felt the affection of a brother), while she divided with him those tender attentions which her aunt's infirmities required, relieved him of a charge for which he was peculiarly ill qualified, by her friendly superintendence of his domestic economy.

THE accession to his income which his new office brought him enabled him to gratify, to a much greater extent than his former circumstances admitted of, the natural generosity of his disposition; and the state of his funds at the time of his death, compared with his very moderate establishment, confirmed, beyond a doubt, what his intimate acquaintances had often suspected, that a large proportion of his annual savings was allotted to offices of secret charity. A small, but excellent library, which he had gradually formed with great judgment in the selection; and a simple, though hospitable table, where, without the formality of an invitation, he was always happy to receive his friends, were the only expences that could be considered as his own.*

THE change in his habits which his removal to Edinburgh produced, was not equally favourable to his literary pursuits. The duties of his office, though they required but little exertion of thought, were yet sufficient to waste his spirits and to dissipate his attention; and now that his career is closed, it is impossible to reflect on the time they consumed, without lamenting that it had not been employed in labours more profitable to the world, and more equal to his mind.

DURING the first years of his residence in this city, his studies seemed to be entirely suspended; and his passion for letters

* SOME very affecting instances of Mr SMITH's beneficence, in cases where he found it impossible to conceal entirely his good offices, have been mentioned to me by a near relation of his, and one of his most confidential friends, Miss Ross, daughter of the late PATRICK ROSS, Esq; of Inverness. They were all on a scale much beyond what might have been expected from his fortune; and were accompanied with circumstances equally honourable to the delicacy of his feelings and the liberality of his heart.

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ters served only to amuse his leisure, and to animate his conversation. The infirmities of age, of which he very early began to feel the approaches, reminded him at last, when it was too late, of what he yet owed to the public, and to his own fame. The principal materials of the works which he had announced, had been long ago collected ; and little probably was wanting, but a few years of health and retirement, to bestow on them that systematical arrangement in which he delighted ; and the ornaments of that flowing, and apparently artless style, which he had studiously cultivated, but which, after all his experience in composition, he adjusted, with extreme difficulty, to his own taste *.

THE death of his mother in 1784, which was followed by that of Miss DOUGLAS in 1788, contributed, it is probable, to frustrate these projects. They had been the objects of his affection for more than sixty years ; and in their society he had enjoyed, from his infancy, all that he ever knew of the endearments of a family. He was now alone, and helpless ; and, though he bore his loss with equanimity, and regained apparently his former cheerfulness, yet his health and strength gradually declined till the period of his death, which happened in July 1790, about two years after that of his cousin, and six after that of his mother. His last illness, which arose from a

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* MR SMITH observed to me, not long before his death, that after all his practice in writing, he composed as slowly, and with as great difficulty, as at first. He added, at the same time, that Mr HUME had acquired so great a facility in this respect, that the last volumes of his History were printed from his original copy, with a few marginal corrections.

IT may gratify the curiosity of some readers to know, that when MR SMITH was employed in composition, he generally walked up and down his apartment, dictating to a secretary. All MR HUME's works (I have been assured) were written with his own hand. A critical reader may, I think, perceive in the different styles of these two classical writers, the effects of their different modes of study.

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chronic obstruction in his bowels, was lingering and painful; but had every consolation to sooth it which he could derive from the tenderest sympathy of his friends, and from the complete resignation of his own mind.

A FEW days before his death, finding his end approach rapidly, he gave orders to destroy all his manuscripts, excepting some detached essays, which he entrusted to the care of his executors; and they were accordingly committed to the flames. What were the particular contents of these papers, is not known even to his most intimate friends; but there can be no doubt that they consisted, in part, of the lectures on rhetoric, which he read at Edinburgh in the year 1748, and of the lectures on natural religion and on jurisprudence, which formed part of his course at Glasgow. That this irreparable injury to letters proceeded, in some degree, from an excessive solicitude in the author about his posthumous reputation, may perhaps be true; but with respect to some of his manuscripts, may we not suppose, that he was influenced by higher motives? It is but seldom that a philosopher, who has been occupied from his youth with moral or with political enquiries, succeeds completely to his wish in stating to others, the grounds upon which his own opinions are founded; and hence it is, that the known principles of an individual, who has approved to the public his candour, his liberality, and his judgment, are entitled to a weight and an authority, independent of the evidence which he is able, upon any particular occasion, to produce in their support. A secret consciousness of this circumstance, and an apprehension, that by not doing justice to an important argument, the progress of truth may be rather retarded than advanced, have probably induced many authors to withhold from the world the unfinished results of their most valuable labours; and to content themselves with giving the general sanction of their suff-

frages to truths which they regarded as peculiarly interesting to the human race *.

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THE additions to the Theory of Moral Sentiments, most of which were composed under severe disease, had fortunately been sent to the press in the beginning of the preceding winter; and the author lived to see the publication of the work. The moral and serious strain that prevails through these additions, when connected with the circumstance of his declining health, adds a peculiar charm to his pathetic eloquence; and communicates a new interest, if possible, to those sublime truths, which, in the academical retirement of his youth, awakened the first ardours of his genius, and on which the last efforts of his mind reposed.

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IN

* SINCE writing the above, I have been favoured by Dr HUTTON with the following particulars.

"SOME time before his last illness, when Mr SMITH had occasion to go to London, he enjoined his friends, to whom he had entrusted the disposal of his manuscripts, that in the event of his death, they should destroy all the volumes of his lectures, doing with the rest of his manuscripts what they pleased. When now he had become weak, and saw the approaching period of his life, he spoke to his friends again upon the same subject. They entreated him to make his mind easy, as he might depend upon their fulfilling his desire. He was then satisfied. But some days afterwards, finding his anxiety not entirely removed, he begged one of them to destroy the volumes immediately. This accordingly was done; and his mind was so much relieved, that he was able to receive his friends in the evening with his usual complacency.

"THEY had been in use to sup with him every Sunday; and that evening there was a pretty numerous meeting of them. Mr SMITH not finding himself able to fit up with them as usual, retired to bed before supper; and, as he went away, took leave of his friends by saying, "I believe we must adjourn this meeting to some other place." He died a very few days afterwards."

Mr RIDDELL, an intimate friend of Mr SMITH's, who was present at one of the conversations on the subject of the manuscripts, mentioned to me, in addition to Dr HUTTON's note, that Mr SMITH regretted, "he had done so little." "But I meant (said he) to have done more; and there are materials in my papers, of which I could have made a great deal. But that is now out of the question."

THAT.

Account of
Dr Smith.

IN a letter addressed, in the year 1787, to the Principal of the University of Glasgow, in consequence of his being elected Rector of that learned body, a pleasing memorial remains of the satisfaction with which he always recollects that period of his literary career, which had been more peculiarly consecrated to these important studies. "No preferment (says he) could have given me so much real satisfaction. No man can owe greater obligations to a society than I do to the University of Glasgow. They educated me; they sent me to Oxford. Soon after my return to Scotland, they elected me one of their own members; and afterwards preferred me to another office, to which the abilities and virtues of the never to be forgotten Dr HUTCHESON had given a superior degree of illustration.

THAT the idea of destroying such unfinished works as might be in his possession at the time of his death, was not the effect of any sudden or hasty resolution, appears from the following letter to Mr HUME, written by Mr SMITH in 1773, at a time when he was preparing himself for a journey to London, with the prospect of a pretty long absence from Scotland.

MY DEAR FRIEND,

Edinburgb, 16tb April 1773.

As I have left the care of all my literary papers to you, I must tell you, that except those which I carry along with me, there are none worth the publication, but a fragment of a great work, which contains a history of the astronomical systems that were successively in fashion down to the time of DES CARTES. Whether that might not be published as a fragment of an intended juvenile work, I leave entirely to your judgment, though I begin to suspect myself that there is more refinement than solidity in some parts of it. This little work you will find in a thin folio paper book in my back room. All the other loose papers which you will find in that desk, or within the glass folding doors of a bureau which stands in my bedroom, together with about eighteen thin paper folio books, which you will likewise find within the same glass folding doors, I desire may be destroyed without any examination. Unless I die very suddenly, I shall take care that the papers I carry with me shall be carefully sent to you.

I EVER am, my dear Friend, most faithfully your's,

ADAM SMITH.

To DAVID HUME, Esq;
St Andrew's Square.

" stration. The period of thirteen years which I spent as a member of that society, I remember as by far the most useful, and therefore, as by far the happiest and most honourable period of my life; and now, after three and twenty years absence, to be remembered in so very agreeable a manner by my old friends and protectors, gives me a heart-felt joy which I cannot easily express to you."

Account of Dr Smith.

THE short narrative which I have now finished, however barren of incident, may convey a general idea of the genius and character of this illustrious Man. Of the intellectual gifts and attainments by which he was so eminently distinguished;—of the originality and comprehensiveness of his views; the extent, the variety and the correctness of his information; the inexhaustible fertility of his invention; and the ornaments which his rich and beautiful imagination had borrowed from classical culture;—he has left behind him lasting monuments. To his private worth the most certain of all testimonies may be found in that confidence, respect and attachment, which followed him through all the various relations of life. The serenity and gaiety he enjoyed, under the pressure of his growing infirmities, and the warm interest he felt to the last, in every thing connected with the welfare of his friends, will be long remembered by a small circle, with whom, as long as his strength permitted, he regularly spent an evening in the week; and to whom the recollection of his worth still forms a pleasing, though melancholy bond of union.

THE more delicate and characteristical features of his mind, it is perhaps impossible to trace. That there were many peculiarities, both in his manners, and in his intellectual habits, was manifest to the most superficial observer; but, although to those who knew him, these peculiarities detracted nothing from the respect

Account of
Dr Smith.

respect which his abilities commanded ; and, although to his intimate friends, they added an inexpressible charm to his conversation, while they displayed, in the most interesting light, the artless simplicity of his heart ; yet it would require a very skilful pencil to present them to the public eye. He was certainly not fitted for the general commerce of the world, or for the business of active life. The comprehensive speculations with which he had been occupied from his youth, and the variety of materials which his own invention continually supplied to his thoughts, rendered him habitually inattentive to familiar objects, and to common occurrences ; and he frequently exhibited instances of absence, which have scarcely been surpassed by the fancy of BRUYERE. Even in company, he was apt to be engrossed with his studies ; and appeared, at times, by the motion of his lips, as well as by his looks and gestures, to be in the fervour of composition. I have often, however, been struck, at the distance of years, with his accurate memory of the most trifling particulars ; and am inclined to believe, from this and some other circumstances, that he possessed a power, not perhaps uncommon among absent men, of recollecting, in consequence of subsequent efforts of reflection, many occurrences which, at the time when they happened, did not seem to have sensibly attracted his notice.

To the defect now mentioned, it was probably owing, in part, that he did not fall in easily with the common dialogue of conversation, and that he was somewhat apt to convey his own ideas in the form of a lecture. When he did so, however, it never proceeded from a wish to ingross the discourse, or to gratify his vanity. His own inclination disposed him so strongly to enjoy in silence the gaiety of those around him, that his friends were often led to concert little schemes, in order to bring him on the subjects most likely to interest him. Nor do I think I shall be accused of going too far, when I say, that he

was

was scarcely ever known to start a new topic himself, or to appear unprepared upon those topics that were introduced by others. Indeed, his conversation was never more amusing than when he gave a loose to his genius, upon the very few branches of knowledge of which he only possessed the outlines.

Account of
Dr Smith.

THE opinions he formed of men, upon a slight acquaintance, were frequently erroneous; but the tendency of his nature inclined him much more to blind partiality, than to ill-founded prejudice. The enlarged views of human affairs, on which his mind habitually dwelt, left him neither time nor inclination to study, in detail, the uninteresting peculiarities of ordinary characters; and accordingly, though intimately acquainted with the capacities of the intellect, and the workings of the heart, and accustomed, in his theories, to mark, with the most delicate hand, the nicest shades, both of genius and of the passions; yet, in judging of individuals, it sometimes happened, that his estimates were, in a surprising degree, wide of the truth.

THE opinions, too, which, in the thoughtlessness and confidence of his social hours, he was accustomed to hazard on books, and on questions of speculation, were not uniformly such as might have been expected from the superiority of his understanding, and the singular consistency of his philosophical principles. They were liable to be influenced by accidental circumstances and by the humour of the moment; and when related by those who only saw him occasionally, suggested false and contradictory ideas of his real sentiments. On these, however, as on most other occasions, there was always much truth, as well as ingenuity, in his remarks; and if the different opinions which, at different times, he pronounced upon the same subject, had been all combined together, so as to modify and limit each other, they would probably have afforded materials for a decision, equally comprehensive and just. But, in the society of his friends, he had no disposition to form those qualified conclusions

Account of
Dr Smith.

clusions that we admire in his writings ; and he generally contented himself with a bold and masterly sketch of the object, from the first point of view in which his temper, or his fancy, presented it. Something of the same kind might be remarked, when he attempted, in the flow of his spirits, to delineate those characters which, from long intimacy, he might have been supposed to understand thoroughly. The picture was always lively, and expressive ; and commonly bore a strong and amusing resemblance to the original, when viewed under one particular aspect ; but seldom, perhaps, conveyed a just and complete conception of it in all its dimensions and proportions.—In a word, it was the fault of his unpremeditated judgments, to be too systematical, and too much in extremes.

BUT, in whatever way these trifling peculiarities in his manners may be explained, there can be no doubt, that they were intimately connected with the genuine artlessness of his mind. In this amiable quality, he often recalled to his friends, the accounts that are given of good LA FONTAINE ; a quality which in him derived a peculiar grace from the singularity of its combination with those powers of reason and of eloquence which, in his political and moral writings, have long engaged the admiration of Europe.

In his external form and appearance, there was nothing uncommon. When perfectly at ease, and when warmed with conversation, his gestures were animated, and not ungraceful ; and, in the society of those he loved, his features were often brightened with a smile of inexpressible benignity. In the company of strangers, his tendency to absence, and perhaps still more his consciousness of this tendency, rendered his manner somewhat embarrassed ;—an effect which was probably not a little heightened by those speculative ideas of propriety, which his recluse habits tended at once to perfect in his conception, and to diminish his power of realizing. He never sat for his

picture ; but the medallion of TASSIE conveys an exact idea of his profile, and of the general expression of his countenance.

Account of
Dr. Smith.

THE valuable library that he had collected he bequeathed, together with the rest of his property, to his cousin Mr DAVID DOUGLAS, Advocate. In the education of this young gentleman, he had employed much of his leisure ; and it was only two years before his death, (at a time when he could ill spare the pleasure of his society), that he had sent him to study law at Glasgow, under the care of Mr MILLAR ;—the strongest proof he could give of his disinterested zeal for the improvement of his friend, as well as of the esteem in which he held the abilities of that eminent Professor.

THE executors of his will, were Dr BLACK and Dr HUTTON ; with whom he had long lived in habits of the most intimate and cordial friendship ; and who, to the many other testimonies which they had given him of their affection, added the mournful office of witnessing his last moments.

1870. *Sixty-ninth year.* To facilitate mining operations
and construction of the canal, it is proposed to have a large
amount of the valley bottom of each stream cleared of all
trees and shrubs, and the ground leveled by hand labor, so as
to make a surface to which the soil may be applied.
The amount of land required will depend upon the
width of the valley, the height of the cut, and the number of days
the work will be continued. It is estimated that one man
can clear 100 square feet of land per day, and that the
work will require 100 men to do the work. The cost of the
work will be \$100 per acre, and the total cost of the work
will be \$100,000,000.

DONATIONS presented to the ROYAL SOCIETY of Edinburgh,
continued from the preceding Volume.

From the Author.

On the Diseases of the Lymphatic Glands, by James Johnstone, M. D. Worcester. 1787.

From the Author.

Mémoire sur les Isles Pionces, et Catalogue Raisonné des Produits de l'Etna, par M. le Commandeur de Dolomieux. Paris 1788.

From Colonel Hugh Montgomery of Skelmorey.

Drawings of a Stone found at Coilsfield in Ayrshire, June 15. 1789.

From Lord Daer.

An Esquimaux Dress. March 1. 1790.

From Mr Somerville Wilson, Surgeon to the Winterton East Indiaman.

Two Persian MSS. in folio, and an Arabic MS. in quarto. On the latter is this inscription: " MS. of part of the Arabian Nights Entertainments in Arabic, written by Moulla Mustapha at Bassora, and rescued with the original MS. from the said Mustapha's house after his death of the plague in April 1773."

From Colonel Macleod of Macleod.

Three MSS. in the Shanscrit. No. 1. is a copy of the GITA, which is translated by Mr Wilkins.

No. 2. is the IRI BAGHAWAT, or the Life of the Indian APOLLO.

No. 3. the CHANDI. See Asiatic Researches, vol. i. p. 280.

Also a MS. of the KORAN in folio. The above are all very beautifully illuminated. The three first are in rolls.

List of Dona-
tions.

From the Author.

Traité Analytique des Mouvements apparens des Corps Célestes,
tom. ii. par M. du Sejour.

From the Author.

Mémoire sur la Combustion du Gas Hydrogène, par M. Seguin.
Paris 1790.

From the Author.

Observations on the Diseases of Fruit and Forest Trees, by Mr Forfyth, Kensington gardens. Nov. 7. 1791.

From the Royal Society of London.

Philosophical Transactions, vol. lxxx.

From the Author.

A treatise on the Angina Pectoris, by Dr Butter of London.

From the Literary and Philosophical Society at Manchester.

Memoirs of the Society, vol. iii. and vol. iv. part 1.

From the Author.

*Annali di Chimica, tom. i. di L. Brugnatelli, Sostituto alla Catedra
di Chemica nel universita de Pavia.* 1790.

From the Author.

*Experimental Inquiry concerning the Cheltenham Water, and
Cautions concerning the Poison of Lead and Copper, by
A. Fothergill, M. D. F. R. S. Lond. &c.*

From the Author.

*Observations on Scrophulous Affections, by Robert Hamilton,
M. D. Lond. 1791.*

From.

From *James Byers, Esq;*

Lift of Dona-
tions.

A Series of ancient Roman Weights of Basaltes or Porphyry.

Dec. 19. 1791.

From the Author.

On Electricity, with occasional Observations on Magnetism, by
E. Pelt, M. D. 1791.

On the Properties of Matter and the Principles of Chemistry,
by the same. 1792.

On Electric Atmospheres, by the same. 1793.

From the Royal Society of Antiquaries in Scotland.

The Transactions of the Society, vol. i. 1792.

From Professor *Heyne* of Gottingen.

Beschreibung der Ebene von Troja, &c. being a translation of
M. Chevalier's paper, [No. I. Lit. Cl. of this Vol.] made
under the eye of Professor Heyne. Leipsic 1792.

From the Royal Irish Academy.

A Standard Thermometer, constructed by *Samuel Healy*, Dublin.

POST-

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POSTSCRIPT TO THE HISTORY.

ON Monday, the 4th of November 1793, Dr HOPE, Professor of Medicine in the University of Glasgow, read a paper, entitled, *An Account of a Mineral from Strontian, and of a peculiar Species of Earth which it contains.* Want of room, and the length of the dissertation, prevent its appearance in the present volume. But as the discovery of a new earth cannot fail to be interesting, it has been thought proper to trespass a little on the order of time, and to insert here the following abstract.

THE mineral is found in the lead-mine of Strontian in Argyleshire. It was brought to Edinburgh about six years ago in considerable quantity. It was generally received as the aerated barytes. At that time, Dr HOPE had some doubts of its being the barytic spar, and used, in his prelections, when he filled the chemical chair in the University of Glasgow, to mention such of its distinguishing characters as he had then discovered. The Strontian spar sometimes is colourless, oftener it has a greenish or yellowish hue. Its texture is fibrous, and it frequently shoots into crystals, which are slender spiculæ or hexagonal columns. The specific gravity of it goes from 3.650 to 3.726.

THIS mineral is insipid, and requires nearly 800 times its weight of water to dissolve it. It effervesces with acids, and during solution carbonic acid is disengaged to the amount of 30.2 grains *per cent.* When moderately heated, it crackles, and loses its transparency. By a very vehement heat, the carbonic acid is expelled, and the mass loses 38.79 *per cent.* of its weight, and ceases to effervesce with acids. The calcined spar, when water is poured on it, swells, bursts, and becomes hot in a greater degree, and with more rapidity, than lime. It is acrid,

acid, and is soluble in water. The solution of it has a taste not unlike that of lime-water, changes to a green, paper stained with the juice of violets or radishes, and on exposure to the air quickly acquires a crust on its surface.—The earth of Strontian mineral, which Dr HOPE denominates Strontites, requires about 180 times its weight of water, at a low temperature, for its solution. In boiling water, it dissolves much more abundantly, and is deposited during cooling in the form of crystals. These crystals are transparent and without colour, in the shape of quadrangular plates, sometimes square, more commonly oblong, with the margins cut like a wedge. Now and then are seen solid parallelopipeds and cubes. On exposure to the action of the air, they become white, powdery and effervescent, losing almost $\frac{1}{2}$ of their weight. In a dull red heat, they undergo the aqueous fusion, and a white refractory powder remains. They contain 68 per cent. of humidity. Distilled water, at temperature 60, dissolves them slowly, in the proportion of 8.5 grains to the ounce. An ounce of water, at a temperature sufficient to keep the solution boiling, dissolved no less than 218 grains. This remarkable solubility affords a discriminating feature of this earth. An hundred parts of the Strontian mineral consist, of earthy basis 61.21, of carbonic acid 30.20, and of water 8.59.

Dr HOPE next details at great length the phenomena attending the action of sulphuric, nitric, muriatic, acetous, oxalic, tartaric, fluoric, phosphoric, arsenic, succinic, boracic and carbonic acids on Strontian mineral in mass and in fine powder, and describes the properties of the resulting compounds in regard to sensible qualities, effects of air and of heat, and solubility in water. It may suffice to extract only from what is said on the action of nitric and muriatic acids. Strong nitric acid scarcely attacks the spar, unless assisted by heat. If duly diluted, it dissolves it rapidly and completely. The solution is colourless and transparent, and having a pungent taste, yields

crystals readily, which, when most regular, are octohædral, consisting of two quadrangular pyramids, united at their bases. They effloresce in a dry atmosphere, in a moist they deliquesce. One ounce of distilled water, at temperature 60, dissolves an equal weight of this nitrate of Strontites; when boiling, one ounce, seven drachms, fourteen grains. It deflagrates on hot coals. Subjected to heat in a crucible, it decrepitates gently, melts and boiling loses its acid. The contact of a combustible body at this time causes a deflagration, with a beautiful vivid red flame.

MURIATIC acid assaults the Strontian mineral in a manner very similar to the nitric. The solution is free from colour, has a penetrating peculiar taste, and affords crystals freely. These are long slender spiculæ or hexagonal prisms. Muriate of Strontites, in a very moist air, shows a disposition to attract humidity, contains 42 per cent. of water, and when heated, first undergoes the aqueous, then a true fusion, but without loss of acid, which may be expelled by a more vehement heat. One ounce of distilled water, at temperature 60, dissolved twelve drachms, one scruple; when boiling above four ounces.

STRONTITES, and all its combinations, possess the remarkable property of tinging flame of a red colour. The muriate has it in the most eminent degree, and its effects are well exhibited by putting a portion of the salt on the wick of a candle, which is thereby made to burn with a very beautiful blood-red flame. The nitrate stands next, then crystallized Strontites, and after it the acetite. The following combinations of little solubility give comparatively a very feeble tinge: Tartrite, sulphate, oxalate, fluate, arsenicate, carbonate, phosphate, and borate. The order of enumeration denotes their relative tinging powers.

A CERTAIN portion of humidity, either belonging to the composition or added, is necessary to enable any of these Strontitic salts to alter the hue of the flame. The muriate itself, deprived of moisture, produces no effect.

ALL the solutions of Strontites in acids are decomposed by the three alkalies in their effervescent state, and in part by virtue of a double elective attraction. The artificial carbonate of Strontites thus obtained, parts with its fixed air more readily than the native. Pure potass separates Strontites from nitric and muriatic acids, but partially, and in a crystalline form. Neither prussiate of potass nor of lime cause a precipitate in any of the solutions.

STRONTITES generates a hepar with sulphur either in the humid or dry way. Its crystals are sparingly dissolved by alcohol; a yellow coloured tincture results.

AFTER finishing the detail of the properties of the Strontian mineral and its earthy basis, Dr HOPE proceeds to enquire, whether this fossil and its earth are similar to any that are already known. He concludes they are not. Strontian spar resembles most the aerated terra ponderosa, and in several respects has a strong analogy with it; yet it essentially differs.

Its specific gravity is less, it parts with its carbonic acid when urged by heat, somewhat more readily, and without suffering fusion; when calcined, it imbibes moisture with vastly greater avidity, swelling and cracking with more heat and noise. Strontites dissolves much more abundantly in hot water than barytes, and the form of the crystals of these pure earths is very dissimilar. The compounds generated by Strontites differ from those of barytes. It will suffice to mention the nitrate and muriate. This earth, united to nitric and muriatic acid, forms salts that suffer changes from exposure to air, which do not happen to the nitrate and muriate of barytes. They are likewise much more soluble in water, and have crystals of a peculiar figure.

THE combinations of Strontites with acids are not, like those of barytes, decomposed by prussiate of lime or of potass.

STRONTITES.

STRONTITES and its compounds tinge flame, which barytes does not. Lastly, these earths disagree in the order of their attractions.

FROM these considerations, it is concluded, that the mineral is not aerated barytes.

SOMETIMES the Strontian fossil resembles calcareous spar; yet they essentially differ in property and composition. That from Strontian is much heavier, and retains its fixed air with more obstinacy in the fire. The incomparably greater solubility of the pure earth in hot than in cold water, and the crystalline form it assumes, sufficiently distinguish it from lime, which the disposition of the nitrate and muriate to crystallize, no less tends to do.

THE quality of colouring flame does not serve here as a circumstance of discrimination, as Dr HOPE has discovered, that muriate of lime also tinges the flame of a red colour, but in a less vivid manner. Strontites further differs from lime in the order of its attractions.

No parallel is drawn between Strontian mineral and other earthy bodies, as they have not the smallest resemblance.

As the earthy basis of the Strontian spar possesses remarkable qualities, that are peculiar to it, and forms with acids combinations unlike those generated by the known earths, and differs from all of them in the order of its attractions, the author of the paper concludes, that it is an earth *sui generis*, a separate and distinct genus, constituting the sixth simple earth, to which, as above mentioned, he gives the appellation of *Strontites*.

Dr HOPE afterwards details a long train of experiments to establish the order of the attractions of this new earth; first, determining the order in which the principal acids attract it, and then showing the place due to its attraction among those of other substances for acids. The tables that are subjoined exhibit these attractions.

Dr.

Dr HOPE likewise read some observations on the native carbonate of barytes or aerated terra ponderosa of Dr WITHERING. The two following deserve most to be noticed.

AFTER quoting the words of Doctors WITHERING and PRIESTLEY, M. SAGE, FOURCROY, PELLETIER, and of Mr WEDGEWOOD junior, to show, that they all agree in asserting, that the fixed air cannot be expelled by heat from this substance, he mentioned several experiments, in which heat alone deprived it of its carbonic acid, rendered the earth caustic, and caused a loss of weight equal to 23 per cent. He described the qualities of the calcined barytic spar.

THE second observation of importance relates to the crystallization of the pure barytes, which substance he has obtained in beautiful and regular crystals; the more obvious, as well as chemical properties of which he at full length recounted.

TABLES shewing the attraction of and for STRONTITES.

TAB. I.

STRONTITES.	Sulphuric Acid.
Sulphuric Acid.	Barytes
Oxalic	Strontites
Tartarous	Potash
Fluoric	Soda
Nitric	Lime
Muriatic	
Succinic	
Phosphoric	
Acetous	
Arsenic	
Boracic	
Carbonic	

T A B. II.

Sulphuric Acid.	Oxalic.	Tartarous.	Fluoric.	Nitric.
Barytes	Barytes	Lime	Lime	Barytes .
Strontites	Lime	Barytes	Barytes	Potash
Potash	Strontites	Strontites	Strontites	Soda
Soda	Potash	Potash	Potash	Strontites
Lime	Soda	Soda	Soda	Lime
Muriatic.	Arsenic.	Phosphoric.	Boracic.	Carbonic.
Barytes	Lime	Lime	Lime	Lime
Potash	Barytes	Barytes	Barytes	Barytes
Soda	Strontites	Strontites	Strontites	Strontites
Strontites	Potash	Potash	Potash	Potash
Lime	Soda	Soda	Soda	Soda

The Brackets in Tab. II. denote, that it has not been discovered how Strontites stands with regard to Barytes and Lime, in its attraction for the acid below which this mark is made.

END OF THE HISTORY.

T R A N S A C T I O N S
OF THE
ROYAL SOCIETY OF EDINBURGH.

VOL. III. PART II.

PAPERS READ BEFORE THE SOCIETY.

ЗИОНОВИЧ

СЕРГЕЙ ТО

ПОДАЧА СКРОБАКОВ

Я

ДЛЯ ПРИЧЕРНОГО МОРЯ

I.

PAPERS OF THE PHYSICAL CLASS.

I. EXPERIMENTS and OBSERVATIONS on the UNEQUAL REFRANGIBILITY of LIGHT. By ROBERT BLAIR, M. D.

[Read Jan. 3, and April 4. 1791.]

BY the discovery of the different refrangibility of light, Sir ISAAC NEWTON laid open the true cause of the principal imperfection of refracting telescopes; and having inferred from the experiments which he made, that the refraction of the different rays composing the prismatic spectrum, was always in a given ratio to the refraction of the mean refrangible ray, this great philosopher was led to conclude, that the imperfection which he had discovered in dioptrical instruments was without remedy.

IF Sir ISAAC NEWTON had been questioned concerning the possibility of refracting light, without any divergency of the heterogeneal rays, his reply without doubt would have been, that all his experiments, whether by single refractions or by opposite refractions, tended to establish the contrary conclusion. But that he would have asserted nothing beyond this, may safely be inferred from his own memorable words: " Although " the arguing from experiments and observations by induction " be no demonstration of general conclusions, yet it is the best

" way of arguing which the nature of things admits of, and
" may be looked upon as so much the stronger by how much
" the induction is more general; and if no exception occur
" from phenomena, the conclusion may be pronounced gene-
" rally; but if at any time afterwards any exception shall
" occur from experiments, it may then begin to be pronounced
" with such exceptions as occur."

THIS is the general doctrine which he lays down as applicable in all experimental enquiries; and so far was he from considering the particular case above mentioned as an exception to this general rule, that from some expressions he makes use of, it evidently appears, that he was not without suspicion, of what has since been discovered to be the truth.

IN his sixth letter to MR OLDENBURGH, dated from Cambridge in the year 1662, he expresseth himself in the following words: " Mr HOOK thinks himself concerned to reprehend
" me for laying aside the thoughts of improving optics by re-
" fraction. What I said there was in respect of telescopes of
" the ordinary construction, signifying that their improvement
" is not to be expected from the well figuring of glasses, as op-
" ticians have imagined. But I despaired not of their im-
" provement by other constructions, which made me cautious
" to insert nothing that might intimate the contrary. For al-
" though successive refractions which are all made the same
" way, do necessarily more and more augment the errors of
" the first refraction, yet it seemed not impossible for contrary
" refractions so to correct each others unequalities, as to make
" their difference regular; and if that could be conveniently
" effected, there would be no farther difficulty. Now to this
" end I examined what may be done, not only by glasses alone,
" but more especially by a complication of diverse succeſſive
" mediums; as by two or more glasses or crystals, with water,
" or some other fluid, between them; all which together may
" perform the office of one glass, especially of the object glass,

" on

"on whose construction the perfection of the instrument
"chiefly depends. But what the results in theory or by trials
"have been, I may possibly find a more proper occasion to de-
"clare."

IN the year 1757, the late Mr JOHN DOLLOND, in consequence of some strictures on Sir ISAAC NEWTON from abroad, repeated the noted experiment of refracting a ray of light through prisms of glass and water, placed with their refracting angles in opposite directions, and so proportioned to each other, that the ray, after these opposite refractions, emerged parallel to the incident ray. According to the Newtonian doctrine, there ought here to have been no divergency of the heterogeneal rays, and no colour produced by these equal and opposite refractions.

BUT this was not the result of the experiment. The ray was coloured very sensibly; and the author of the experiment finding that he could, by these opposite refractions, produce colour, notwithstanding the parallelism of the incident and emergent light, with reason concluded that he might, by properly proportioning the refracting angles of his prisms, effect an inclination of the refracted to the incident light, without any colour or divergency. The event turned out as he expected.

PUSHING his experiments farther, he discovered, some time afterwards, that a colourless refraction might be produced by a combination of different kinds of glass, as well as by a combination of glass and water, which seemed to remove completely the great obstacle to the perfection of the refracting telescope, discovered by Sir ISAAC NEWTON.

As it was found soon afterwards, that the other principal imperfection which limits the performance of telescopes, namely, the aberration arising from the spherical figures of lenses, might be corrected by properly proportioning to each other the sphericities of the convex and concave lenses, of which the compound object glass is composed; it was expected by men of science, that an increase of the aperture and power of the instrument,

strument, would be the necessary consequence of such important steps, towards the perfection of its theory. These expectations have not hitherto been fully answered.

IF the theory of the achromatic telescope is so complete as it has been represented, may it not reasonably be demanded, whence it proceeds, that HUGENIUS and others could execute telescopes with single object glasses eight inches and upwards in diameter, while a compound object glass of half these dimensions, is hardly to be met with? or how it can arise from any defect in the execution, that reflectors can be made so much shorter than achromatic refractors of equal apertures, when it is well known that the latter are much less affected by any imperfections in the execution of the lenses composing the object glass, than reflectors are by equal defects in the figure of the great speculum?

THE general answer made by artists to enquiries of this kind, is, that the fault lies in the imperfection of glass, and particularly in that kind of glass of which the concave lens of the compound object glass is formed, called flint-glass.

IT was in order to satisfy myself concerning the reality of this difficulty, and to attempt to remove it, that I engaged in the following course of experiments. The result of this investigation I now do myself the honour of submitting to the Royal Society.

THE imperfections of glass for optical purposes arise partly from its want of perfect transparency, and from being more or less affected with a tinge of some particular colour, but principally from irregularities which are frequently found in its refractive density. This last imperfection is so constant an attendant upon flint-glass, and every other kind of glass which possesses the dispersive quality in a considerable degree, that it has been suspected, not without appearance of reason, to arise necessarily from that ingredient in its composition on which this

this quality depends. It is certain that great labour and expense have been bestowed on this object without the desired effect.

CONSIDERING therefore that it is not impossible to introduce a fluid medium to supply the place of one of the lenses, in the compound achromatic object glass, I was desirous of searching whether nature afforded fluids possessed of the requisite qualities.

IT appears from the passage already quoted, that Sir ISAAC NEWTON not only suspected that optical instruments might admit of improvement by a combination of solid and fluid mediums, but had actually made experiments on the subject, and considered this as the most likely means of carrying these instruments to their greatest perfection.

Dr DAVID GREGORY, Savilian professor of astronomy at Oxford, entertained similar ideas on this subject, as appears from his treatise, entitled, "Catoptricæ et Dioptricæ Sphæricæ Elementa." In this work, which was published at Edinburgh in the year 1713, he treats of optical instruments, both by refraction and reflection; and, after shewing the advantages of the latter in theory, concludes his treatise with the following words: "Quod si ob difficultates physicæ, in speculis idoneis "torno elaborandis et poliendis, etiamnum lentibus uti oportet, fortassis media diversæ densitatis ad lentem objectivam "componendam adhibere utile foret, ut a natura factum obseruemus in oculi fabrica, ubi christallinus humor (fere ejusdem cum vitro virtutis ad radios lucis refringendos) aqueo et "vitreo (aque, quoad refractionem, haud absimilibus) conjungitur, ad imaginem quam distinctè fieri potuit, a natura nihil frustra molienti, in oculi fundo depingendam: sed et "alii sunt in animalis oculo, prædicti artificii usus, qui non "sunt hujus loci."

THIS coincidence of opinion of these great opticians respecting the ultimate perfection attainable by the telescope, deserves

to be remarked. Various attempts of this kind have been made by later philosophers and artists. Indeed, the structure of the eye, composed of solids and fluids variously combined, seems to present so obvious and instructive a pattern for imitation, that it is no wonder if the expectations entertained of the productions of art, rose in proportion as they could be made to approach the construction of this exquisite model of Divine workmanship.

Mr DOLLOND's first experiments went no farther than to prove to him, that glass disperses the heterogeneal rays of light more than water, when the refraction of the mean refrangible ray is equal in both mediums. With these scanty data, this able artist zealously went to work to construct telescopes on this new discovered principle. But on this occasion his attempts were not attended with any degree of success. This need not much be wondered at. Besides the difficulty he mentions, arising from the spherical aberration, (which, by the by, if he had considered the matter more attentively, he would have seen to be easily surmountable) he would find between plate-glass and water, but an inconsiderable difference of dispersive power; and if he made use of flint-glass he would have all those difficulties to struggle with, which his successors have not been able to remove, though fully apprized of their cause.

THIS want of success in his first trials with fluids, and the discovery he soon after made of a difference in the dispersive power of different kinds of glass, which he was more successful in applying to the improvement of telescopes, seems to have put an end to all thoughts of the use of fluids, nor has any thing of that kind been since attempted, as far as I have been able to learn, some unsuccessful trials excepted, to construct those small perspectives called opera glasses, on a plan similar to that of Mr DOLLOND, by including spirit of wine between two concave meniscuses of flint-glass, the fluid supplying the

place

place of crown-glass, and the advantage proposed being a saving of the light lost by reflection.

THE experiments of Mr DOLLOND proved, that the dispersive power of water is less than that of the glass with which he made his experiments; and it seems wonderful that this should have been almost the only attempt made to investigate this quality in fluid mediums. We find many tables ascertaining the mean refractive density of fluids, from experiments made both before the discovery of DOLLOND and since. But though some of the fluids examined were possessed of the dispersive quality in a remarkable degree, this is passed over unobserved, and it would seem unsuspected, if we except the very ingenious conjecture of Mr MICHEL; to whom it occurred, that the apparent difference in the experiment above mentioned, made by Sir ISAAC NEWTON, from the same experiment repeated by Mr DOLLOND, might arise from the former using, instead of pure water, a solution of Saccharum Saturni, which he mentions his having sometimes made use of to increase the refraction. Mr MICHEL suspected that lead, even in this form, might increase the dissipative refraction, as it does in the composition of glass. The result of his experiments on this subject may be seen in the additions to Dr PRIESTLEY's Optics, at the end of the second volume:

Of the methods employed for investigating the optical qualities of different mediums.

IN ascertaining the mean refractive and dispersive qualities of fluids, I made use of two kinds of apparatus. Where the properties of the fluids were entirely unknown, prisms were employed to come to a gross knowledge of their properties, and those fluids which promised to be of use in the practical part of optics, were more critically examined by means of lenses, where

the effect, from being magnified, becomes more conspicuous.

THE prismatic apparatus consists of a small prism of brass, whose three angles are equal. Through this prism, and parallel with one of its sides, are bored two holes at a small distance from each other, equal in size to the pupil of the eye. The sides of the prism are ground flat, and there are two bits of glass with parallel sides, of the same dimensions as the sides of the prism. There are also prisms of the same size, and with the same angles of different kinds of glass, and some crown-glass prisms, with smaller angles, which, by being applied to the large prism, or to each other, vary the refracting angle at pleasure.

WHEN it is proposed to try the properties of any fluid, one of the small plates of glass is applied over the holes on the side of the brass prism. A few drops of the fluid are then dropped into the hole; and when it is full, the other plate is laid over the holes upon the opposite side, and the whole is secured by tying a bit of pack-thread round the ends. One of the glass prisms is now to be applied to the brass prism, contiguous with one of the parallel plates, the refracting angles of the two prisms being placed in opposite directions, so as to form a small parallelepiped.

NOTHING farther is necessary than to apply the eye to the hole which contains the fluid, in such a way as to observe through it any bright well defined object. The bars of the window answer the purpose very well in the day-time, and the moon, or a candle in the night. The intention of the two holes is for the sake of greater expedition. The properties of two fluids may thus be examined and compared at the same time.

As the prismatic portion of fluid and the glass prism have equal refracting angles, and refract in opposition to each other, it will easily be understood, that if the object seen through the

two prisms coincides with the same object seen directly, the mean refractive density of both mediums will be the same. When this is the case, if the object seen through these prisms appears free from prismatic colour, the dispersive power of the fluid medium is also the same with the dispersive power of the glass prism. But otherwise they will be different.

THOSE mediums, it is to be observed, are said to have the same mean refractive density, which, under equal obliquities of incidence, equally refract the mean refrangible rays, and two mediums are said to have the same dispersive power, which produce an equal inclination of rays of the same colour, to the mean refrangible ray, when the whole refraction of the mean refrangible ray is equal in both.

WHEN an object, seen through the equal wedges of glass and fluid, appears coloured, one of the smaller glass wedges is to be applied and shifted till the object appears colourless. It is easy to distinguish, by the order in which the prismatic colour lies, whether the small prism is to be applied in such a way as to increase the dispersion of the rays occasioned by the fluid, so as to enable it to counterbalance that of the glass; or whether the refracting angle of the glass prism requires to be enlarged, to enable it to counteract the dispersion occasioned by the fluid.

By proceeding in this way to shift the angles of the prisms, till, first, the direct and refracted images of an object coincide, without regarding the colour; and, next, till the refracted image appears colourless, without regarding the coincidence; the ratio of the mean refractive and dispersive powers of that kind of fluid, and that kind of glass, with which the experiments are made, will be obtained, from the angles of the prisms being given in both cases.

IN order to ascertain the absolute refractive density of glass, or any other medium, that is to say, the general ratio of the sines of the angles of incidence to the sines of the angles of re-

fraction of the mean refrangible ray, which obtains in that medium, I took a direct method, similar in principle to that employed by Sir ISAAC NEWTON, and described by him in the seventh proposition of the first book of his Optics, and likewise in his Optical Lectures, p. 54. ; but which I may venture to say will be found much easier, and perfectly accurate.

INSTEAD of causing the rays to pass through the sights of a large and accurate quadrant, at the distance of ten or twelve feet, as directed by Sir ISAAC NEWTON, I employed a HADLEY's quadrant, in the following manner :

FIG. 1.—I represents the index-glass and H the horizon-glass of a HADLEY's quadrant. S I represents a solar ray, incident on the index-glass, thence reflected to the horizon-glass H, and from it to the eye at E. The line sg represents another solar ray, incident on the prism P, and through it refracted to the eye at E. When the prism is turned slowly round its axis, till the spectrum G appears at its greatest height, this is its proper position. The angle formed by the direct and refracted ray is then the least possible, and the angles of incidence and emergence are equal. Let the prism be secured in this position. A slight inspection of the figure will shew, that when the reflected and refracted images of the sun are made to coincide, the angle marked by the index of the quadrant, is the same which the incident ray sg forms with the refracted ray PE produced. For SZH is the angular distance of the sun and his doubly reflected image, marked by the index ; and the angle sgG, which the ray incident on the prism forms with the refracted ray produced, is equal to it ; sg and SI being parallel, and PZ and HZ being coincident.

THE manner in which the ratio of the sines of the angles of incidence and refraction may be computed from the above angle, and the refracting angle of the prism being given, is fully explained in the celebrated works which have just been quoted.

It may be proper here to remark, that as it is the ratio of refraction of the mean refrangible ray which is wanted, the centre of the reflected image of the sun ought to be made to coincide with the centre of the coloured spectrum, as represented in the figure; and if, instead of this, the coincidence is formed with the most or least refrangible ray, or any of the intermediate rays, it will be the ratio of refraction of these rays, and not of the mean refrangible ray, which will be found from the observation. Hence this method might be practised for determining the dispersive power, as well as the mean refractive density of any transparent substance, whether solid or fluid; but I have preferred a combination of prisms or lenses, because it is the relative ratios, more than the absolute ratios, which are most immediately wanted.

Experiments on the dispersive powers of fluids.

I EXAMINED, by the prismatic apparatus which has been described, the optical properties of a great variety of fluid mediums. It will suffice to mention the most remarkable of these. Many solutions of metals and semi-metals, in different forms, were subjected to trial, and these were always found to be more dispersive than crown-glass. The solution of some salts in water, as for instance of crude sal ammoniacum, greatly increases its dispersive power. The marine acid disperses very considerably, and this quality increases with its strength. Hence I found the most dispersive fluids to be those in which the marine acid and the metals are combined. The chemical preparation called *causticum antimoniae* or *butyrum antimonii*, in its most concentrated state, when it has just attracted sufficient humidity to render it fluid, possesses the quality of dispersing the rays in such an astonishing degree, that three wedges of crown-glasf are necessary to remove the colour produced by one wedge of this substance,

substance, of an equal refracting angle, opposed to them. The great quantity of the semi-metal retained in solution, and the highly concentrated state of the marine acid, seem to be the cause of this scarce credible effect.

CORROSIVE sublimate mercury, added to a solution of crude sal ammoniacum in water, possesses the next place to the butter of antimony among the dispersive fluids which I examined. It may be made of such a degree of strength, as to require a wedge of crown-glass, of double the refracting angle, to remove the colour which a prism of it produces. The mercury and marine acid contained in this solution, are manifestly the cause of its dispersive power. For neither the water nor the volatile alkali, which are its other component parts, will be found capable, if tried separately, of contributing towards this effect.

THE essential oils were found to hold the next rank to metallic solutions, among fluids which possess the dispersive quality. The most dispersive I found to be those obtained from bituminous minerals, such as the native petrolea, pit-coal and amber. When the refraction is without colour, the proportion of the refracting angle of a prism of these, to the refracting angle of a prism of crown-glass acting in opposition, is about two to three. The dispersive power of the essential oil of sassafras, is not much inferior to these. The essential oil of lemons, when genuine, requires the refracting angles of the prisms necessary to produce a colourless refraction, to be as three to four. In oil of turpentine, this proportion is as seven to six; and the essential oil of rosemary is still less dispersive.

SOME expressed oils which were examined, were found not to differ sensibly in dispersive power from crown-glass, which was also the case with rectified spirits, and with nitrous and vitriolic æther.

A VARIETY of other fluids were examined in the same way; but not having yet collected them into a table, I have only mentioned, in general terms, the most remarkable.

HAVING been thus successful beyond my hopes, in discovering fluids capable of removing the great imperfection of telescopes, arising from the different refrangibility of light, the next object was, to select from this variety those which seemed best adapted to optical purposes.

THERE can be no doubt that those mediums which most disperse the rays, are, *cæteris paribus*, to be preferred. It will also be found, when the method of correcting those errors, which arise from the spherical figures of lenses, comes to be considered, that there is apparently an advantage in using a dispersive medium, whose mean refractive density exceeds the mean refractive density of crown-glass.

As the antimonial caustic possesses both these advantages, in a degree far beyond what was to be expected in any fluid, I included some of it between two double convex lenses of crown-glass, whose radii of convexity were as two to one. The least convex sides of these were turned towards each other, and they were kept at a proper distance by means of a glass-ring. The cavity was then filled with the strongest butter of antimony. Here it is evident that there is a concave lens of the dispersive fluid, acting in opposition to the two convex lenses of crown-glass, and that the proportion of the radii of these is the same which was found by the prisms to correct the colour, namely, three wedges of crown-glass, to one of the butter of antimony.

THIS compound object-glass being put into a tube, an eye-glass was applied, and, according to expectation, the colour was found to be removed. But I was surprised to find, on directing the instrument to a planet, and using a deep eye-glass, that this fluid, in its highly concentrated state, was subject, like flint-

flint-glass, to great irregularities in its density, discoverable by streams of light, like comet's tails, issuing in different directions from the disc of Venus, which was the planet observed. By shaking the object-glass, these might be, in a great measure, removed, but soon returned; and after standing all night, broad veins, in different parts of the included fluid, were perceptible to the naked eye.

IT was necessary on this account to reject very dense fluids. The antimonial preparation I found might be reduced to a sufficient degree of fluidity, by mixing it with spirit of wine or vitriolic æther, into which a small quantity of the marine acid had been previously dropped. This prevents any precipitation of the semi-metal in the form of a calx. In this diluted form, either this preparation, or the solution of corrosive sublimate mercury alone, in spirit of wine, or in water, with the addition of crude sal ammoniacum, may be employed for producing refraction without colour, and without being subject to that irregularity of density to which flint-glass, and very dense dispersive fluids, are subject.

BUT as solutions of saline substances in this diluted state do not differ materially in dispersive power from the essential oils, these two kinds of fluids may be used indifferently.

THERE is, however, a particular case, in which water or vitriolic æther, impregnated with antimony or mercury, will have the advantage, from being less dense than essential oils; and that is, where it is required to produce a single refraction, in which there shall be no difference of refrangibility of heterogeneal light. As this expression may found strange in the ears of opticians, I shall, before proceeding farther in the application of the experiments which have been recited, explain what is meant by it.

Cases of refraction in which the violet rays are least refrangible, and the red rays most refrangible; or in which all the rays are equally refrangible; or in which the red rays are refracted from the perpendicular, and the violet rays towards the perpendicular, while the mean refrangible rays suffer no refraction.

IT has been mentioned, that when prisms of crown-glass and oil of turpentine refract in opposition, the transmitted light is colourless, when the proportion of the refracting angles of these prisms is as seven to six. Hence, if oil of turpentine be included between two double convex lenses, the radii of whose convexities are as six to one, and the deep sides of these be placed inwards, so as to be in contact with the fluid; in the refraction through this compound lens, the aberration from the difference of refrangibility will be removed. I can prove the truth of what I write, by a compound object glass of this kind, which I have had in my possession above four years. It is twenty inches in focal length, and its performance as a telescope, with one inch and a half of aperture, is not contemptible. Now, it has long ago been ascertained, that the mean refractive density of oil of turpentine is less than that of glass; and thence I affirm, that when light passes from crown-glass into oil of turpentine, a considerable refraction of the whole pencil from the perpendicular takes place, and the violet rays are, in this case, the least refrangible, and the red rays the most refrangible.

THIS is manifest from the facts which have just been stated. In the object-glass above mentioned, there are four refractions, all of which are made in the same direction; namely, two refractions at the two external surfaces of the lenses, which are in contact with air, and two at the internal surfaces, which are in contact with oil of turpentine.

IN the refractions which take place in the confine of glass and air, it has been put beyond all doubt, by Sir ISAAC NEWTON's experiments, that the red rays are least refracted, and the violet rays most refracted ; and it is equally clear, from what has just been mentioned to be the result of trials with prisms, and from the correction of colour in the above mentioned object-glass, that when light passes obliquely out of crown-glass into oil of turpentine, it is refracted from the perpendicular, and the red rays are most refracted, and the violet rays least refracted. If this were otherwise, the heterogeneal rays, which are made to diverge in two refractions, which take place in the confine of glass and air, could never have this divergency removed by the refractions made in the confine of glass and the fluid. It is manifest, that if, in these last mentioned refractions, the separation of the heterogeneal rays ~~were~~ in the same order as in the refraction from air into glass, the colour and divergency of the rays, instead of being removed by them, would be increased.

I SHALL not enter upon the application of this fact to the best received theories of refraction ; but it may be worth while to remark the great importance of minute accuracy in observing the results of experiments. Dr HOOK attempted to make object-glasses of telescopes, by interposing a fluid between a plano-convex lens, and a piece of glass, both sides of which were plane and parallel. The convex side of the lens was turned inwards ; and the author seems to have had no other view in this scheme, but to obviate the difficulty which was found in giving a good figure to lenses ground to very long radii. The refraction being thus reduced to that which takes place in the confine of glass and the fluid employed, may be diminished in any proportion, and consequently the focal length of the object-glass lengthened at pleasure. One of the fluids which he appears to have made use of, was oil of turpentine. The difference between the phenomena attending an object-glass of this construction

construction and a simple lens, if they had been attentively observed, would have led Dr HOOK to the truth ; and a man of his zeal and invention would not have failed to apply the discovery to the improvement of optics, not to mention the triumph it would have afforded the opponent and rival of NEWTON, to have asserted, and had it in his power to make good his assertion, that in some cases the violet rays are the least refrangible, and the red rays the most refrangible.

EVEN Mr DOLLOND could not conceive that the prismatic colour could be corrected by refractions which are all made the same way ; and still less would he have admitted that single refractions may take place without divergency or colour *. As this continues to be the opinion of the best informed opticians of the present day, it will be necessary to enter into a more explicit investigation of the subject.

FIG. 2. Let ABC represent a glass prism, and BCD a prism of water in contact with it ; and let the angles of these prisms be so proportioned to each other, that a ray of light SI, which enters the glass prism perpendicularly, shall, after being refracted from the perpendicular at the point G, in passing out of the glass into the water, emerge at K, perpendicular to the side CD of the water prism, which is supposed to be confined by parallel plates of glass. As the ray both enters and emerges from the refracting mediums perpendicularly, it will suffer no refraction, excepting when it passes from the glass into the water, where its incidence is oblique. Here it will be refracted from the perpendicular, and will emerge coloured, the violet rays being most refracted, and the red rays least refracted.

LET the water be now impregnated with antimony or mercury, to increase its dispersive power. As this will also increase its mean refractive density, and occasion a diminution of the

* Philosophical Transactions of London, vol. I. page 740.

refraction in passing into it from the glass, conceive the angle BCD to be diminished as the refraction diminishes, so that the refracted ray GK shall still emerge perpendicular to DC. When the angles of the glass prism and prism of dispersive fluid bear to each other a certain proportion, the ray will be found to emerge colourless; and when this happens, it is evident that all the rays are equally refracted at the point G, in passing out of the glass into the fluid. For they suffer no other refraction whatever.

THIS is a necessary consequence of the glass and fluid differing in their mean refractive density, and of the rarer medium possessing the requisite degree of dispersive power.

THIS case of a single refraction taking place, without any difference of refrangibility of the rays, may be illustrated by Sir ISAAC NEWTON's explication of refraction, by means of attraction, in the following manner. He supposes refraction to arise from an attracting force acting on light, in lines perpendicular to the surface of the medium; and the cause of one kind of rays being more refracted than another, to arise from their being more attracted.

WHEN the medium is surrounded by a vacuum, the refraction will be proportioned to the whole attracting force of that medium. But when light passes from one refracting medium into another, it will only be attracted by the difference between their attracting forces, as they act in opposition to each other.

NOW, if the difference of attraction of the most and least refrangible rays were, in all mediums, proportioned to the whole attraction of the mean refrangible ray, it would be impossible to produce refraction without colour*. But subsequent

experiments

* This at least is true as to sense in those small refractions which take place in telescopes and microscopes; and it would be mathematically true in all cases, if the angles of incidence and refraction were proportional. But as it is not the angles themselves which are so, but their sines, it is a mistake to suppose that colourless refraction cannot be produced by large contrary refractions of the same medium, properly disposed for the purpose.

experiments have proved, that this supposed general law of refraction does not hold in nature.

IN the instance before us, if we suppose the force with which glass attracts the red, green and violet rays to be represented by the numbers five, six and seven; then may the force with which the dispersive fluid attracts these rays, be represented by the numbers four, five and six. For the reason why all the rays are equally refracted in their transition from one of these mediums into the other, is because the rare medium has the property of refracting the violet rays more, and the red rays less, than the dense medium, when the obliquity of incidence is so proportioned to their density, that the mean refrangible ray shall suffer the same refraction in both.

Now, in the case above stated, the attraction of the rare medium for the several rays, is so proportioned to the attraction of the dense medium for these same rays, that the difference of these attractions is every where equal, and consequently the refraction arising from these differences of attraction is also equal. Thus the green ray is attracted by the dense medium with the force six, and by the rare medium with the force five, the difference of which is one; and there is the same difference between the attracting forces acting on the red and violet rays in the two mediums, being in one case the difference between five and four, and in the other between six and seven; so that the difference of attracting force, and consequently the refraction supposed to arise from it, is the same in all the rays, being always that which will be produced by an attracting force, represented by unity.

IF the dispersive power of the rare medium, of which the prism B C D is formed, be still farther increased, the red rays will become the most refrangible, and the violet rays the least refrangible; a law of refraction, which, as has been already explained, obtains when light is refracted in the confine of crown-glass and oil of turpentine, and of many other fluids.

If the mean refractive density of the dispersive fluid, contained in the prism B C D, be so far increased as to become equal to the mean refractive density of the glass prism A B C, the mean refrangible ray will suffer no refraction in passing obliquely from the one medium into the other at the point G, but the violet ray will be refracted towards the perpendicular, and the red ray will be refracted from the perpendicular. The reason of which is, that the dispersive medium refracts the violet ray more, and the red ray less than the other medium; so that the former may be considered as an equally dense medium with the latter relative to the green ray, but more dense relative to the violet ray, and less dense relative to the red ray.

THIS case of refraction takes place in the confine of crown-glass and butter of antimony, when the latter is so far diluted as to have the same mean refractive density with crown-glass; that is to say, when both mediums equally refract the green ray, under equal obliquities of incidence.

THESE varieties of refraction will possibly be better comprehended by the assistance of diagrams.

FIG. 3. represents a prism of crown-glass, which is entered perpendicularly by a red, green and violet ray, moving parallel with each other. As their incidence on the second surface of the prism is oblique, they will, in passing from the glass into air, be refracted from the perpendicular. This deflection of the light from its rectilineal course, is supposed to be produced by the perpendicular attracting forces, represented by the numbers five, six and seven. The violet ray will therefore be most deflected, the green next, and the red ray least.

FIG. 4. represents a prism of dispersive fluid, which the three rays enter with the same degree of obliquity which they had before they emerged from the glass prism. The attracting forces of the fluid for the several rays, are represented by the numbers

numbers four, five, six ; and each of them will be deflected towards the perpendicular, in a degree proportioned to the force acting on it.

FIG. 5. represents the two prisms in contact, and the three rays entering the glass prism perpendicularly, and emerging perpendicularly from the fluid ; so that the only refraction they suffer in their passage, is in the confine of the two mediums.

At the point of contact, the rays will be acted on by both mediums, with the same forces which they exerted when separate. But these forces will act in opposition, and therefore the rays will only be affected by their difference ; and as the difference of attraction of the two mediums is the same in all the rays, they will all be equally refracted. The red ray is attracted towards the glass by the difference between the forces four and five, the green by the difference between five and six, and the violet by the difference between six and seven, each of which differences is equal to unity, as represented in the figure.

If the dispersive power of the fluid, contained in the prismatic vessel, be diminished by decreasing the proportion of mercury or antimony which it contains, the violet ray will begin to be more refracted, and the red ray less refracted, than the green ray. But if that quality be increased, the contrary of this will happen ; the red ray now becoming the most refrangible, and the violet ray the least refrangible.

If the dispersive medium employed, be of that precise degree of strength, which enables it to refract the green ray in the same degree in which it is refracted by crown-glass ; in this case it has been asserted, that when light passes obliquely from the one of these mediums into the other, the green rays will suffer no refraction, but the red rays will be refracted from the perpendicular, and the violet rays towards the perpendicular. The reason of this will appear from inspecting the three following diagrams.

FIG. 6. represents a prism of crown-glass, in which the red, green and violet rays, at their emergence into air, are attracted, as before, with the forces five, six and seven.

FIG. 7. represents a prismatic vessel filled with butter of antimony, whose mean refracting force is equal to that of the crown-glass, so that the green ray is attracted by it with the force six. But in consequence of its great dispersive power, the red and violet are attracted, (we shall suppose for the sake of round numbers) with the forces four and eight.

FIG. 8. represents the two prisms in contact, and consequently acting in opposition to each other. Now, the force with which each of the mediums acts on the green ray, is represented by six; the difference between which being nothing, the green ray will proceed in its rectilineal course, as it would do in the same uniform medium.

BUT as the red ray is attracted by the crown-glass with a force represented by five, and by the dispersive medium with a force equal only to four, it will, in passing out of the former into the latter, be deflected towards the crown-glass, by the difference between these forces, which is equal to unity.

THE violet ray, on the contrary, is attracted by the crown-glass with the force seven, and by the dispersive medium with the force eight, and will therefore be refracted towards the latter, in the same degree in which the red ray is refracted from it, as represented in the figure. It is a circumstance worth remarking, that a particle of red light, and a particle of violet light, under precisely the same circumstances of exposure to the action of gross bodies, should be urged in contrary directions.

I HAVE tried these several cases of refraction likewise with compound object-glasses, which shew the effect better than the prisms. Thus, if a plano-convex lens have its plane side turned

ed towards a distant object, the rays will enter it, as to sense, perpendicularly, and will therefore suffer no refraction. If the convex surface of this lens be brought in contact, with a fluid of less mean refractive density than the glass, but exceeding it in dispersive power, in that degree which occasions an equal refraction of all the rays, all these rays will then be converged to the same point, which are incident at the same distance from the axis of the lens. The focal distance of this compound lens will be greater or less in proportion to its radius of convexity, and to the difference of refraction between it and the fluid made use of. While the fluid is confined on one side by the plano-convex lens, let the lens which is brought in contact with it on the opposite side, have one of its sides ground convex, and the other concave ; the radii of their sphericities being equal to the focal distance at which the rays are made to converge, by the refraction which takes place, when light passes from the plano-convex lens into the fluid. It is manifest that the light will now both enter into this compound lens, and emerge from it perpendicularly, and will therefore suffer no refraction, except in the confine of the convex side of the plano-convex and the dispersive fluid, where all the rays are equally refrangible. A compound lens of this kind, is represented in the ninth figure, which, after what has been said, will require no farther explanation ; excepting only, that instead of being spherical, it is represented with that curvature which converges homogeneal rays, incident at all distances from the axis, to the same point. If the required curvature could be given to lenses with sufficient accuracy, this figure seems to represent as perfect a construction of the object-glass of a telescope as can be desired. But there is reason to think that a spherical figure may be communicated, not only much easier, but with greater accuracy than a spheroidal or hyperboloidal, which would be required ; and even if this difficulty could be got over, there would still remain a fundamental fault in the theory. Before relating the

observations by which this was detected, it will be requisite to explain the method of removing the spherical aberration, by a combination of convex and concave lenses. For next to the indistinctness arising from the unequal refrangibility of light, this aberration, occasioned by the spherical figures of lenses, is the great obstacle to the advancement of the powers of vision.

Of the aberration from the spherical figure.

THIS subject has been treated of in all the variety of cases which can occur in single glass lenses, by the great HUGENIUS, in his Dioptrics, a posthumous work. He there demonstrates that the quantity of this aberration is very different in different lenses of the same focal distance, according to the convexities or concavities of their two sides, and the manner in which these are exposed to parallel rays.

IN convex lenses, those rays which pass at a distance from the axis, are converged to a point nearer to the lens than its geometrical focus. The distance between the point at which the external ray of a pencil incident on a lens, intersects its axis and the geometrical focus, is called the linear aberration of that lens.

HUGENIUS demonstrates, that when a plano-convex lens is exposed to parallel rays, with its plane side towards them, this aberration will amount to four times and a half the thickness of the glass. By the thickness of a convex lens is meant its greatest thickness in the middle, after subtracting its thickness, if it has any, at the outer edge; and by the thickness of a concave lens, is meant its thickness at the external edge, after deducting its thickness in the middle.

ON turning the convex side of the lens towards the light, the linear aberration will only exceed the thickness of the lens by one sixth part.

WHEN

WHEN both sides of a lens are convex, and the proportion of their convexities is as one to six, if the most convex side be exposed to parallel rays, the aberration will exceed the thickness of the lens one fourteenth, which is the smallest possible aberration of any convex lens.

IF it is required to increase the aberration, this may be done by grinding one side of the lens convex, and the other side concave, to a longer radius. Such a lens, with its concave side turned towards parallel rays, will have more aberration than any plano-convex or double convex lens of the same focal distance.

HUGENIUS proceeds to shew, that the same aberration is produced by concave lenses as by similar convex ones. When a plano-concave lens is exposed to parallel rays, with its plane side outward, the external ray of the pencil, being produced backward after refraction, will intersect the axis of the lens nearer to it than its focus, by four times and a half the thickness of the lens. But if its concave side be exposed to the parallel rays, the aberration will only exceed the thickness of the lens one fourteenth part. A double concave, whose radii are as one to six, with the most concave side turned outward, disperses the rays with the least aberration; and a concave meniscus, with its convex side outward, produces more aberration than any plano-concave or double concave lens, of an equal focal distance.

THESE are sufficient data for correcting the aberration from the spherical figure, in cases where both a convex and concave lens are required, in the construction of the compound object-glaſs.

FIG. 10. Let AB represent a convex lens receiving a pencil of rays from the object S, and converging rays incident near the axis, as ST, to the point F; and external rays, as SB, to the point

D 2

D;

D ; so that DF represents the greatest linear aberration in this case.

AGAIN, let GH (Fig. 11.) represent a concave lens, receiving the parallel rays SH, RK, which it refracts in the lines HX and KV. This ray KV being produced backward, will intersect the axis of the lens nearly at the point N, which is called the virtual focus of the concave ; and the external ray HX produced backward, will intersect the axis in some point P nearer to the lens than its focus, PN being the linear aberration.

It may here be observed, that the convex is in that position which produces the least aberration, and the concave in the position which produces most aberration. Hence, to render the aberrations DF (Fig. 10.) and PN (Fig. 11.) equal, the focal distance of the convex must be much shorter than that of the concave ; and if the distances of the points F and N from the convex and concave lenses be required to be the same, as represented in the figures, then must the object be placed much nearer to the convex. Hence the image of the near object S, is represented at the same distance from the convex lens in figure tenth, as the virtual focus of the concave in figure eleventh, where it is represented as receiving parallel rays, which are supposed to come from an infinitely distant object.

Now, when the distance between K and N, which is the point from which parallel rays are made to diverge by the concave lens, is equal to the distance between T and F, which is the point to which rays issuing from S are made to converge by the convex ; and when the aberrations DF and PN are also equal ; I say, that in this case, if the two lenses be placed contiguous, in the manner represented in the twelfth figure, parallel rays, incident on these lenses, will be converged to the point S, without any aberration of the external ray.

FOR it is an axiom in optics, that if a ray of light after refraction be returned directly back to the point of incidence, it will be refracted in the line which was before described by the incident ray.

IF therefore we conceive the whole of the light emitted from the point S (Fig. 10.), and converged by the convex lens towards the points D and F, to be returned directly back from these points, it will be accurately converged to the point S, whence it issued. Now, the parallel rays S H, R K, (Fig. 11.) after their emergence from the concave lens, in the lines H X, K V, are precisely in the same relative situation, as the rays supposed to be returned directly back from F and D are in, at their incidence on the convex; and therefore, when these lenses are placed contiguous, in the manner represented in the twelfth figure, parallel rays incident on the concave lens, and immediately after their emergence from it, entering the convex lens, will be accurately converged to the point S, without any aberration.

THIS, which is the most simple case, will suffice to explain the nature of that aberration, which arises from the spherical figures of lenses, and a method of obviating it by combining a convex and concave.

THE demonstration is perfect as far as regards the external ray, which is here represented passing from the external part of the concave into the external part of the convex, in immediate contact with it; and if the surfaces of the two lenses, which respect each other, were either in contact or parallel, it would be true with regard to all the rays. But as this is not the case, there arises a small secondary aberration, the effect of which only becomes sensible in large apertures.

HENCE may be understood the reason why the indistinctness arising from the spherical figures of lenses, may, in the common achromatic telescope, be more nearly removed in those constructions of object-glasses in which three lenses are employed,

ployed; than in those composed only of two; and also the advantages in this respect, which may be derived from introducing fluid mediums, which differ from glass in their mean refractive density, and in the quantity of aberration produced by their refractions. For it will be found upon computation, that when the fluid medium is rarer than glass, the aberration from the spherical figure is increased, and becomes greater in proportion as its density diminishes. Now, by making the density of the fluid medium approach nearer and nearer to the density of the glass with which it is in contact, we may increase the rarity of our refracting medium, or, which amounts precisely to the same thing, diminish the difference of density of the two mediums at pleasure.

IT will appear from what has been explained, that the aberration from the figure cannot be corrected by interposing a dispersive fluid between two convex lenses, of a greater refractive density than the interposed fluid. For all the refractions being made the same way, tend to converge the external rays to points nearer the lens than its geometrical focus. Hence, when rare fluids are made use of to remove the aberration from the difference of refrangibility, some farther contrivance becomes necessary to correct the spherical aberration.

THE most obvious way, and which on trial I found successful, is to include the rare dispersive fluid between two glasses, ground concave on one side and convex on the other, and thus form such a concave as shall be required. By combining this with a convex, an achromatic object-glass may be formed, as represented in the sixteenth figure. The objection to this construction is, that one of the advantages arising from the use of fluids is given up, namely, the prevention of that loss of light by reflection, which is a consequence of the fluid being in immediate contact with the glass, whereas in the present case, the space between the convex and concave is occupied by air.

ON

ON this account I attempted to introduce a third medium, by filling this vacancy with a fluid of the least dispersive kind, and of less mean refractive density than the dispersive fluid. For this purpose I employed sometimes rectified spirit of wine, and sometimes vitriolic æther ; and by giving to the lenses the proper degree of curvature, in which great variety may be introduced, I succeeded in forming object-glasses, in which both aberrations are removed, and hardly any more light lost than in a simple object-glass.

HAVING gained this point, I now determined to try how far the aperture of the object-glass might be increased, without increasing its focal length, expecting, at least, to equal reflectors in this respect. But the first trials to execute object-glasses on this principle, though they left no reason to complain of want of success, when compared with such instruments as are now in use, surprised me with new phenomena, and new obstacles to the perfection of the theory of telescopes, more unaccountable and perplexing than any I had before encountered. These I shall now proceed to give an account of.

Of the imperfect correction of prismatic colour which is obtained by a combination of mediums of different dispersive powers.

I TOOK a compound object-glass of the construction last mentioned, composed of three lenses, two of them plano-convex and the other a meniscus. The radius of convexity of one of the plano-convex lenses is about four inches, and the convex side is turned towards the object. The radii to which both sides of the meniscus are ground, are about five inches, one side being convex and the other side concave. The concave side is made to respect the plane side of the above mentioned plano-convex, and the vacancy between them is filled with vitriolic æther. The third plano-convex lens is ground to a radius of six inches. Its convex side is turned towards the convex side of the

the meniscus, and the vacancy between them is replenished by a fluid of the requisite degree of dispersive power, which is confined by means of a ring of glass. These lenses are two inches and seven eighths of an inch in diameter, and the focal length of the compound object-glass is ten inches; the curvatures of the lenses being so proportioned, as nearly to correct the aberration from the spherical figure.

THE fluid I employed to remove the colour arising from the different refrangibility of light, was an essential oil, whose dispersive quality I could easily increase or diminish, by mixing it with others differing in their dispersive qualities, though of nearly the same mean refractive density; by which means, the correction of the error from the figure was not disturbed, by varying the strength of the dispersive fluid. I now expected perfectly to remove the colour, by adding a little of one or other of the dispersive fluids, as occasion might require.

BEFORE relating the event of this trial, it will be proper to explain the manner of examining the dispersive power of fluids by means of lenses, and of distinguishing when the colour is perfectly corrected.

WHEN the image of a lucid point is formed in the focus of a simple lens, the violet rays are converged to a focus nearest to the lens, and the deep red rays are converged to a focus at the greatest distance from it. The consequence of this is, that if this image be examined by an eye-glass nearer to the lens than is required for distinct vision, it will appear surrounded with a red fringe, which is the prevailing colour of the least refrangible rays; and if the eye-glass be placed at a distance beyond that which is required for distinct vision, it will be surrounded with a blue fringe, which is the prevailing colour of the most refrangible rays.

THE reason of this will appear more clearly from inspecting the thirteenth figure, where the red rays appear outermost within the focus at A, and the violet rays appear outermost beyond

yond the focus at B. These colours may also be seen, when an image of any luminous object, as the sun, is formed by a lens upon a white ground; and they will be so much the more conspicuous, by how much the diameter of the lens is greater, in proportion to its focal distance.

JUST the reverse of this will happen in a compound object-glass, if, in correcting the colour, the medium employed disperses more than it ought to do. A blue fringe will then appear round a luminous object, when the eye-glass is pushed in; and a red fringe, when it is drawn out beyond what is necessary for distinct vision.

IN this way, the correction of the colour may be examined, and the qualities of refracting mediums investigated, to an extreme degree of accuracy; yet the effect will be rendered still more sensible, by covering half the object-glass. For when this is done, the colour produced by the uncovered half of the object-glass appears, without being mixed with that of the opposite side, even when the eye-glass is adjusted to distinct vision. Thus, in Fig. 13. the colours produced by both sides of the lens, are mixed at the general focus F. But if the rays coming from one side be intercepted, those which are refracted by the other side will appear in their proper colours. By these means, and by employing a very luminous object, surrounded by a dark ground, and a high magnifying power, the least uncorrected colour may be rendered sensible.

My first observations, which clearly proved the correction of colour which is obtained by the combination of two mediums differing in dispersive power, to be only partial, were made in the summer of the year 1787, at Merchiston.

I HAD, some time before, found it impossible to succeed, in this respect, with prisms composed of crown and flint glass. But as I neither was able to make the phenomena so apparent by this method as with lenses, nor had a command of prisms with that great variety of refracting angles necessary to put it

beyond all doubt, that the colour observed might not proceed from the angles of the prisms not being precisely those, which would render the correction of colour most perfect, I paid no farther attention to the subject at that time.

IN examining the object-glass above mentioned, the object observed was a small window in a white wall, at the distance of several hundred yards to the eastward of my station, the sun shining upon the wall from the west. The circumstances of the phenomena, which I have extracted from memorandums written at the time of making the experiments, were as follow :

" July 28. 1787. IN construction A, (by this is meant the ten inch object-glass above described), when rendered as achromatic as possible, a purplish light appears on one side the focus, and a greenish light on the other."

IN the next observation of this kind of incorrigible colour, the flame of ARGAND's lamp was used as an object, the great brilliancy of its light rendering the phenomena more conspicuous. A cylinder of brass was placed over the glass-tube, which intercepted all the light, excepting what passed through a small round hole opposite to the flame. I found no object preferable to this for the purpose, except the planet Venus, which cannot always be commanded. My observation mentions, that " with the patent lamp, the colour is deep carmine within the focus, and greenish yellow without it."

ANOTHER memorandum on this subject runs thus : " Construction 10. (by this is meant another object-glass, composed, like the former, of crown-glass, an essential oil, and spirit of wine, instead of æther, but a few inches longer than it, and more perfect) discovers a great deal of colour of some kind, in covering half the object-glass. The object, though coloured, is then more distinct than upon uncovering the other half; the colour is thus converted into mistiness. On altering the dispersion of the fluid, the colour on one side alters from purplish violet

violet to reddish violet, and on the other from greenish orange to greenish blue. As the dispersion is diminished, the red gains on the violet within the focus, and the greenish blue upon the orange without it, and *vice versa*; and there is a considerable latitude, within which, varying the dispersion, makes little difference in the distinctness."

As this last observation put it beyond doubt that an investigation of the cause of these appearances was of the last importance to the improvement of optics, I now began to reason concerning them.

THE first conjecture that offered was, that this colour might somehow proceed from the surfaces of the convex glass lenses, and the concave lenses of dispersive fluids, not corresponding at different distances from the centre, as the plane surfaces of prisms every where do. In order to examine what effect this might have, I procured two pieces of plate-brass, with which I could cover the whole of the object-glass; and out of one of these I caused a ring, of a quarter of an inch in breadth, to be cut towards the centre, and out of the other, a ring of the same breadth, close to the circumference. For I perceived that, if the colour arose from the cause above mentioned, its appearance ought to be different through these two rings, when there is an accurate correction of colour in that part of the object-glass, which is equi-distant from the centre and the circumference. But upon trying the experiment, the same purple and green colour appeared through both these rings, as through the whole object-glass, and the colours lay in the same order in both cases. My remark upon this experiment is in the following words: "Upon trying with a ring either external or internal, the appearances remain the same, as when the whole aperture is used; which seems to prove that this colour arises from the dispersion not being proportional, and not, as was supposed, from the surfaces not corresponding. It is evidently the greatest bar to increasing the aperture, and giving high powers; there

is only a partial correction of colour; the differently refrangible rays cannot all be converged to one focus."

THE next method that occurred to me of determining the point in question was more decisive. This was to observe whether any of this green and purple colour appeared through the most perfect kind of achromatic object-glass above described, and represented in the ninth figure, in which there is only one refraction. This I found to be the case; and therefore considered myself as in possession of sufficient authority for concluding, that the theory advanced by Mr DOLLOND, and generally received, was defective. For with the large aperture and high power made use of in these experiments, the colour that appears in viewing a bright object is not weak and hardly sensible, but a beautiful bright purple inclining to crimson, and a strong full green, and these in such a quantity as evidently to be the obstacle to increasing the aperture of the object-glass.

THIS was the conclusion I was then led to, and which I have found confirmed by numerous experiments made since. But before entering farther on the subject, it will be necessary to explain what is meant by different mediums not dispersing the heterogeneal rays of light proportionally.

LET A B and C D (Figures 14. and 15.) represent the surfaces of two mediums, both of which equally refract the mean refrangible ray. This we shall suppose to be the green ray, though, in this explication, it is not material which is called the mean refrangible ray. The angles of incidence K G L, M R N, will then be equal, and the angles of refraction of the green ray H G g, P R γ, will also be equal in both these mediums.

LET one of these mediums C D exceed the other A B so much in dispersive power, as to make the difference of the angles of refraction of the green ray, and extreme violet ray, in the medium C D, double of what it is in the medium A B; that is to say, the angle ν R γ double the angle ν G g. Then if

if the difference of the angles of refraction of the green ray and deep red ray, in the medium CD, be also double of the difference of the angles of refraction of these rays in the medium AB, that is to say, the angle γR is double the angle $g G$; I should say that the two mediums dispersed these three kinds of rays, namely the red, green and violet rays proportionally. But if, when the difference between the angles of refraction of the green ray, and extreme violet ray, in the medium CD, is double of what it is in the medium AB; the difference of the angles of refraction of the green ray, and deep red ray in the medium CD, shall be found to exceed the difference between the angles of refraction of these rays, in the medium AB, only one half, for example; then I would say that the two mediums do not disperse these differently refrangible rays proportionally.

FOR in this case the medium CD disperses or separates the green ray, and extreme violet ray, twice as much as the medium AB does; whereas the separation of the green ray, and deep red ray, in this same medium CD, exceeds only by one half their separation in the medium AB.

IT is farther manifest, that the red, green and violet rays cannot be rendered parallel by any combination of the refractions of the two mediums, upon the last mentioned supposition. The whole refraction, through a prism composed of the medium CD, may be such as to give exactly the same inclination of the red and violet rays, which a prism composed of the medium AB does, when both rays suffer a greater refraction through the latter; and therefore both these rays may be equally refracted and converged to the same point by means of a convex lens of the least dispersive medium AB, and a concave lens duly proportioned to it, formed of the most dispersive medium CD.

BUT if we now add to these the green ray, it is evident that it too cannot be refracted parallel with the red and violet rays.

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FOR when the whole refraction of the least dispersive medium AB is such as just to unite the red and violet rays, the green ray, which is more refracted by this medium A B, in proportion to the whole refraction of the red and violet rays in the medium A B, than it is refracted by the dispersive medium C D, in proportion to the whole refraction of the red and violet rays in the medium G D, will, when the red and violet rays are united by contrary refractions through these two mediums, be refracted too much ; the balance of refraction being always, in this case, in favour of the least dispersive medium ; and therefore the green light will emerge from this compound refraction more refracted than the united red and violet light, and the inclination of the emergent green light to the emergent united red and violet light, will be greater or less according as the ratio in which the red, green and violet light are separated by the refraction of the two mediums, approaches more or less to equality. What this inclination amounts to, in any particular instance, must be determined by experiment.

HENCE if the case of unproportional dispersion, above stated, should be found to hold true in fact, we shall arrive at this new truth in optics, That though in the refraction of a pencil of solar light, made in the confine of any medium, and a vacuum, the deep red rays are always the least refrangible, and the violet rays are always the most refrangible ; yet it depends entirely on the specific qualities of the medium, which shall be the mean refrangible ray ; the very same ray, which in the refraction through one medium is the mean refrangible ray, being found in others among the less refrangible rays. For it is manifest that the ray which bisects the angle formed by the most and least refrangible rays, and falls in the middle of the coloured spectrum, is to be accounted the mean refrangible ray.

THUS, in Fig. 14. the green ray G_g is the mean refrangible. But in Fig. 15. the green ray R_y is found among the less

less refrangible rays, and some other ray, R_w , which is one of the more refrangible rays in the medium AB, is the mean refrangible ray in this medium CD.

THE most obvious way of examining the optical properties of different mediums, is by means of prisms. But I have not found this method either so easy or so accurate as that by means of lenses, which has been already explained. It has been shewn, that the image of a lucid point (see the thirteenth figure) is every where, between the lens and that point where the rays cross, surrounded with a fringe of the colour of the least refrangible rays; and that every where beyond the point of crossing, the image is surrounded with a fringe of the colour of the most refrangible rays; and that these colours appear more distinctly at the focus itself, when one half of the lens is covered. Hence, in order to determine which rays are the most or least refrangible, after refraction through any lens, whether simple or compound, it is only necessary to examine the colours of these fringes, which is the more easily done, as they are greatly magnified by the eye-glass.

IN single lenses, the fringe within the focus, which is composed of the least refrangible rays, will always be found to be of a red colour, with a mixture of orange; and the fringe beyond the focus, composed of the most refrangible rays, will be found to be of a blue colour. These are the colours which, it is well known, are produced by simple refraction, made in the confine of every known medium and a vacuum.

FROM what hath been already related, it appears, that colour is likewise produced in what has been termed achromatic refraction, though it be less in quantity, in proportion to the whole refraction; and the rays which are found most and least refrangible, in these two cases, differ very widely.

IN a compound object-glass, formed of a concave, which disperses the rays in a greater degree, and a convex, which disperses the rays in a less degree, there was always found, when

the

the correction of colour was rendered the most perfect possible, a fringe of purple within the focus; and a fringe of green beyond the focus; and these coloured fringes appeared, whether the concave consisted of flint-glass, or of an essential oil. Therefore, in this kind of compound refraction, the rays of light, when their union is rendered the most perfect possible, emerge differently refrangible; and the rays which emerge most refrangible, have the property of exciting in us the idea of a green colour; and the rays which emerge least refrangible, have the property of exciting in us the idea of a purple colour.

WHEN, for the sake of brevity, I speak here, or elsewhere, of the union of the red and violet rays, as if it were performed by a single refraction, whereas, in general, the most that can be effected is to render them parallel by opposite refractions, I would be understood to refer to the most simple and perfect case of achromatic refraction, in which the extreme red and violet rays are really equally refracted, and consequently united, by a single refraction, as already explained in the references to the fifth and ninth figures.

THE fringe of purple light is formed in part by an union of the red and violet rays, which in simple refraction differ most in refrangibility, but which are here equally refrangible; and partly of the united orange and indigo light, which are also united, and form the second order of coloured light in this secondary spectrum.

THE green fringe is composed in part of the homogeneous green rays, which, in common refraction, are the mean refrangible, or nearly so, but are now the most refrangible of all. The remainder of this green fringe is formed by an union of the yellow and blue rays, composing what may be termed an heterogeneous green.

IT will appear from the foregoing statements, in what manner this disposition of the rays is a necessary consequence of the

the concave and convex lenses being composed of mediums which do not disperse the rays proportionally, as before explained. But the matter will be best understood, by recurring to the case above mentioned, of single achromatic refraction. Thus I continue to denominate it, though the Society will perceive that this term *achromatic*, is here used with manifest impropriety; and will also make proper allowance for the sense in which I have employed the term *homogeneous light*, in conformity to the common language of optics.

IT was formerly asserted, that when two mediums differ in mean refractive density, and the dispersive power of the rare medium exceeds that of the dense medium in a certain proportion, light of all colours will be equally refracted in the confine of the two mediums; and it is true that the red and violet rays will be equally refracted, and the rays of other colours as nearly so as by any combination of two mediums of different dispersive powers. But on account of the two mediums not attracting, and consequently separating the rays of different colours in a given ratio, the same green and purple-coloured fringes appear in an object-glass of this kind, as in one in which opposite refractions are employed; so that in the refraction which takes place in the confine of two such mediums, the rays of light are still unequally refrangible. But instead of the degree of refrangibility being, as in common refraction, according to the order of the colours, red, orange, yellow, green, blue, indigo, violet, the prismatic spectrum is, as it were, doubled, the rays being, at the same time, compressed nearer to each other; and their degrees of refrangibility being now according to the following order: Red and violet united, the least refrangible; next to these in refrangibility, the orange and indigo united; then the united yellow and blue; and, lastly, the homogeneous green rays, which are the most refrangible.

Of the perfect correction of the aberration arising from the unequal refrangibility of light.

THIS fact now established on the fullest evidence, that the divergency of the heterogenous rays is not to be removed by a combination of crown-glass with flint-glass, or with those dispersive fluids employed in the object-glasses, with which the experiments above related were made, discovered a most important problem in optics, namely, the entire removal of the aberration from the difference of refrangibility of light, by any combination of mediums whatever.

THIS problem, it was evident, was only to be attempted by again having recourse to the volume of nature, and searching out the hidden qualities of refracting mediums. Though in all the compound object-glasses which were examined, after being rendered as achromatic as possible, the same colours appeared, and in the same order; yet every trial could only be considered as speaking for itself, if the expression may be allowed. The experiments were indeed numerous, and will, I hope, be found to have been made with sufficient care and attention; yet to have formed from them any general conclusion, that in every endeavour to unite the rays of all colours, by a combination of mediums differing in dispersive power, the green rays will emerge most refracted, and the red and violet least refracted, as above explained, could only serve to prevent farther investigation, by representing the perfection of the theory of optical instruments by refraction as a desperate attempt.

THE order in which I proceeded farther to explore this subject was the following:

HAVING found fringes of colour, as above described, in combinations of crown-glass with the essential oils, and in combinations of crown-glass and flint-glass, when the refraction is rendered

rendered as colourless as possible, I began by trying other dispersive mediums, which owe this property to different metallic or saline particles with which they are impregnated, in hopes of finding some dispersive medium, which might separate the differently refrangible rays in the same proportion in which crown-glass does, and thus afford a method of refracting all of them alike, and consequently without colour. But I was disappointed. The compound object-glasses, formed of a variety of dispersive fluids and crown-glass, exhibited green and purple fringes, as before, which proved the dispersive power of the two mediums not to be proportional.

My next step was to vary the combination by rejecting glass entirely as a refracting medium, and only employing it to confine the fluids. As a fluid medium was here to be used as a convex lens, those which had been found least dispersive, were to be made choice of. Accordingly, water, spirit of wine, nitrous and vitriolic æther, and all the limpid indispersive fluids I could come at, were made trial of. But still the result was the same. The green and purple fringes appeared, on covering half the object-glass.

I THEN substituted some other of the more perfect indispersive kinds of glass instead of crown-glass; but with no better success.

NEXT I combined two essential oils, both of them more dispersive than crown-glass, but differing so considerably in this respect between themselves, that the less dispersive could be used as a convex, while the other was so disposed as to perform the office of a concave. For it will easily be understood, that lenses of any kind may be formed of fluid mediums, by including them between glasses, which have one side formed convex, and the other concave, to the same radius; and thus serve merely to confine the fluids, without producing themselves any effect in refracting the light. If a flat side is wanted, a piece of plain glass with parallel sides must be used, and in

concave lenses of this kind, the farther contrivance of a glass-ring to confine the fluid is required.

THE effect of the above combination, which was of oil of turpentine with a mineral oil, I immediately perceived to be different from what was observed in the preceding trials. The green and purple fringes still appeared, and they lay in the same order as before; but their breadth was greatly diminished, I judged about one half.

THIS new fact was the only fruit of this last set of experiments, which were attended with much trouble and loss of time. For to make them with the requisite degree of precision, pains must be taken, not only to get the refraction as colourless as the qualities of the mediums will admit, but also to compute the error from the spherical figure, and procure lenses accurately ground to the spheres which are required. Unless these points are duly attended to, accuracy in the results is not to be expected.

I NOW considered how this diminution of the breadth of the coloured fringes, observed in the last mentioned experiment, might best be turned to account. In the first place, it was obvious, that an object-glass, formed by a combination of the mediums used in that experiment, would have an advantage over others, in which the correction of the aberration from the difference of refrangibility is more imperfect. But as this fault, though greatly diminished, would still prevent the use of high magnifying powers, I weighed the circumstances more attentively, and the matter appeared to me in the following light:

A CONVEX lens, formed of the least dispersive of the two essential oils, being so combined with a concave lens, formed of that which is most dispersive, as to unite the red and violet rays, leaves fringes of uncorrected colour, much narrower than those produced by compound object-glasses of the same focal-distance, formed by a combination of either of these fluids

with

with glass. Hence I was led to conclude, that if I took an achromatic convex lens, composed of the two essential oils, and combined it with an achromatic concave lens of a longer focal distance, composed of crown-glass and either of the essential oils, I should be able, through such a double compound object-glass, to converge the rays to a focus, without any aberration whatever from the difference of refrangibility of light. For if the compound convex and compound concave are properly proportioned to each other, the secondary spectrums, or fringes of green and purple, may be rendered of the same breadth in both lenses; and from the observations before related, this will happen when there is a considerable balance of refraction in favour of the convex lens. For it is composed of materials which form a much narrower secondary spectrum, under an equal refraction of the whole pencil, than those mediums do, of which the compound concave is formed.

THIS will be understood, by attending to what takes place in the refractions of light through the lenses, without again recurring to the more simple case of prisms.

FIG. 17. represents a compound concave lens, formed of a concave lens of glass, and a concave lens of a dispersive fluid, but of a shorter focus than the concave lens, and so proportioned as to produce a refraction as free from colour as can be obtained by a combination of these two mediums. This lens being exposed to parallel rays, will make them diverge, after refraction, from its virtual focus, and the united red and violet rays will be the least refracted, and will be inclined in a certain angle to the green rays which are most refracted, as represented in the figure.

FIG. 18. represents a compound convex lens, formed of a convex of an essential oil, which disperses the rays in a lesser degree, combined with a concave of an essential oil, which

which disperses the rays in a much greater degree. The convexity of this compound lens is such, as to unite, at a convenient distance, rays diverging as from the virtual focus of the compound concave. The whole refraction through the convex is consequently much greater than through the concave. But notwithstanding this, the angle formed by the green ray with the united red and violet rays, is represented equal in the two lenses. For as the effect of the mediums of which the compound concave is formed, is to separate the united red and violet rays from the green rays, much more than those of which the compound convex is formed, when the refraction of the pencil is equal, it becomes necessary, in order to render this separation equal in both lenses, to diminish the refraction through the concave.

AN object-glass formed of such a compound concave and compound convex, appears more complicated than it is in reality. It may be rendered complete without employing more than two fluid mediums and three glass lenses, which were found necessary merely to correct the aberration from the spherical figure. Thus, in the nineteenth figure, the two compound lenses are represented in contact; and it is manifest, that the pieces of plain glass with parallel sides, which were necessary to confine the fluid when the lenses were separate, are now useless; for it is the very same fluid which is on both sides of these plain pieces of glass; and as they produce no effect in refracting the light, they are better removed, as represented in this figure.

PARALLEL rays incident on the concave lens, are here represented converged to a focus, without any aberration whatever. This is a necessary consequence of what hath been related concerning the properties of the refracting mediums, of which this compound object-glass is formed.

IN both the concave and convex, the red and violet rays are united, and form the least refrangible rays, and in both, the
green

green rays are the most refrangible. But as the angle formed by these most and least refrangible rays, would be much greater in the concave if the whole refractions were equal, the whole refraction is here represented to be precisely that which is requisite for giving the same inclination of the green rays to the united red and violet rays, which takes place after refraction through the convex. Hence, as these refractions are equal and opposite, they destroy each others effect. The rays proceed after refraction without any divergency from unequal refrangibility; and the aberration from the spherical figure being also corrected by means of the concave glass lens, which is more dense than either of the fluids, they are converged to the same point.

THE construction represented in these figures, is not, however, the most perfect and convenient for the purpose. The best method is to divide the concave glass necessary for removing the secondary colour, by making two of the lenses, or all three of them, concave meniscuses. But throwing the whole concave glass into one lens, and exhibiting the compound convex and compound concave lenses separately, answers best the present purpose of explaining the principle on which the aberration from unequal refrangibility may be totally removed. On the same account, the difference of the dispersive power of the two fluids, is represented greater than it is in reality.

HAVING completed an object-glass of this kind, I carefully examined whether any colour was yet discernible. For though the red and violet and green rays were now united, it was a thing possible, that rays of other colours might still have a small inclination to these. But I could discover no colour by the most rigid test; and therefore conclude the refraction of all the rays of the spectrum to be now equal. If there be any deviation from this equality of refraction, it is insensible; and insensible errors, in those cases where sense is the only judge, may be accounted no errors at all.

I HAD now attained the object I was in search of, namely, a method of refracting equally all the rays of which light is composed. Nor was the construction of object-glasses for telescopes, which it afforded, liable to any very material objection. The principal inconvenience arose from the necessary depth of the spheres of the lenses required, which was now the only remaining obstacle to shortening the refracting telescope at pleasure.

IN the first trials I made to discover a dispersive medium which should separate the rays in the same proportion in which glass does, I was in hopes of perfect success, and therefore not at all curious in observing the breadths of the coloured fringes, still hoping that the next trial might afford a refraction without any colour whatever. I therefore thought it expedient to repeat some of them, with greater attention to that circumstance.

THE first fluid I happened to make trial of, was a metallic solution with a mixture of marine acid. Upon comparing an object-glass, rendered achromatic by this solution, with another as nearly similar to it as possible, in which an essential oil was employed for that purpose, the breadth of the coloured fringes appeared indisputably much narrower in the former than the latter*. I repeated the experiment frequently, to enable me to judge of the proportion of focal distance of a compound concave, necessary to correct this secondary colour, upon the principle which hath just been explained. Upon a comparative trial, I found it better to form the compound convex of a combination of this fluid and glass, than of a combination of two essential oils. The convex was not only shorter itself, with the same depth of spheres, but required a shallower compound

* THE cause, at that time unknown, was, that the solution happened to contain an unusual proportion of the marine acid; as will be understood from what follows.

concave lens to remove the colour entirely. The colour may be totally removed, and the aberration from the figure corrected, by a concave which lengthens the focal distance of the convex only one third.

FROM what hath been explained respecting the total correction of colour, it will be understood, that if the concave lengthens the focal distance beyond what is required, fringes of green and purple ought to begin to appear in an inverted order. This, which may be styled the *experimentum crucis* in this matter, I now had it in my power to try without difficulty. The result turned out exactly as I expected. Upon applying a compound concave, which nearly doubled the length of the compound convex, a fringe of green appeared within the focus, and a fringe of purple beyond it, which sets the theory of the correction of this secondary colour in the most satisfactory light.

THE compound concave in this and all the preceding experiments, was formed of glass and an essential oil.

I now happened, merely with a view of diversifying the experiment, to apply a compound concave, formed of glass combined with the muriatic acid, which has been mentioned as a fluid possessing a considerable degree of dispersive power. This opened a new and unexpected scene. The colours appeared in the same order as in the last experiment, but the fringes were so very broad as greatly to surprise me, and create a suspicion that every thing was not as I had hitherto taken for granted. Without delay I included some of the marine acid between two convex lenses, whose radii were duly proportioned to the dispersive power of that fluid, for the purpose of correcting the colour. Upon applying an eye-glass I found my suspicion verified. The fringes of green and purple appeared nearly of the usual breadth, but in an inverted order, there being now a green fringe within the focus, and a purple fringe beyond it. I was the better pleased at being thus led to the

detection of this singular property of the acid of sea-salt, because, in making the same experiment before, this inversion of the order of the colours had entirely escaped me. I was then examining it, to find whether it dispersed the several orders of rays, in the same ratio in which glass does ; and being satisfied that it did not, from observing the green and purple fringes, as in other combinations, a circumstance so little looked for, as the inversion of the order of the colours, did not strike me.

THIS observation affords a remarkable exception to what I had begun to consider as very probably a general law of nature. In the refraction which takes place in mediums of the least dispersive kind, the green rays, or rather perhaps the rays in the confine of green and blue, are the mean refrangible, and these same rays, in the more dispersive mediums, were always found among the less refrangible rays ; and hence when, by a proper combination of two such mediums, the red and violet rays are united, these united red and violet rays constitute the least refrangible rays, and the green constitute the most refrangible rays, as before explained.

BUT in the muriatic acid, the case is just the reverse of this. Then the green rays, which in mediums that disperse the least, are the mean refrangible, and which in essential oils and metallic impregnations are found among the less refrangible, appear amongst the more refrangible. Whence in such a combination of the muriatic acid and an indispersive medium as shall unite the red and violet rays, these united red and violet rays emerge most refrangible, and the homogeneal green rays emerge least refrangible, being just the reverse of what takes place in combinations of crown-glass with flint-glass, or with essential oils, or saturated metallic solutions.

THIS unusual property of the marine acid does not, however, seem to admit of any immediate application to the improvement of optical instruments. It is true that, instead of having recourse to a compound concave for correcting the secondary

secondary colour, this may be effected by a compound convex, which, instead of lengthening, will shorten the focal distance of the compound object-glass. But in a construction of this kind, the correction of the spherical aberration would be attended with more difficulty.

HAVING thus found an exception to the general result of my former experiments, which was, that those rays which in the least dispersive mediums constitute the mean refrangible rays, are in more dispersive mediums found amongst the less refrangible rays, it seemed not improbable that dispersive mediums might exist, which would separate the differently coloured rays exactly in the same proportion in which they are separated by indispersive mediums.

I HAD now indeed got hold of a pretty sure clue to lead me to mediums possessed of this property. It will appear from what has been said concerning attraction, that when in a metallic solution or an essential oil, which separate the red and violet rays in the same degree in which they are separated by the marine acid, the green rays are found amongst the less refrangible rays in the former fluids, and amongst the more refrangible in the latter fluid, the cause of this difference must be, that the green light is more attracted by the marine acid than by essential oils or metallic solutions, when the attraction for the red and violet light is the same in all these mediums.

HENCE it seemed reasonable to conclude, that in a medium compounded in a due proportion of the particles composing these two kinds of dispersive mediums, the attraction for the green rays would be in an intermediate degree, and might be rendered the same, in proportion to the attraction for the red and violet rays, which obtains in crown-glass and other indispersive mediums.

IT might be found a matter of no small difficulty to unite the essential oils with the marine acid, so as to form a colour-

less transparent fluid. But nothing can be better adapted for this purpose than metallic solutions.

I FIRST made trial of butter of antimony, and found the result to be what I expected. On increasing the proportion of muriatic acid, the fringes of green and purple grew narrower and narrower till they entirely disappeared, and if more was then added they re-appeared in an inverted order. I tried the same thing with a solution of crude sal ammoniac and mercury sublimate. If the solution contains a certain proportion of these two substances, the rays of all colours emerge from the compound object-glass equally refracted. If the proportion of the ammoniacal salt, and consequently of the muriatic acid which it contains, be increased, the green rays, which were the mean refrangible in the dispersive fluid, as well as in crown-glass, draw nearer to the violet, making a part of the more refrangible half of the spectrum, and consequently emerge less refracted than the united red and violet rays, and are converged to a focus at a greater distance from the object-glass ; so that the green fringe now appears within the focus, and the purple fringe beyond it. But on increasing the proportion of mercurial particles, these same green rays shift their situation to the less refrangible half of the spectrum, which appears from their now emerging most refracted, and being converged to a point nearer to the object-glass than the united red and violet, whose refrangibility does not appear to be affected by these admixtures which occasion such remarkable fluctuations in the refrangibility of the green rays and other intermediate orders. It may possibly seem strange at first view, that the green rays should emerge most refracted from the compound object-glass, when their refrangibility in the dispersive medium is diminished, and least refracted under the contrary circumstances. The cause of this is, that the principal refraction of the compound object-glass is performed by the indispersive convex lens,

which

which is opposite to the refraction produced by the dispersive concave.

IT was formerly observed, that in the confine of a rare dispersive medium, and a dense indispersive medium, there may be a single refraction, in which all the rays are equally refrangible; and it has since been explained with what limitation this is to be understood, in consequence of the unproportional dispersion which generally takes place in such mediums; of which I was then ignorant. The explanation which refers to the second, third, fourth and fifth diagrams, and to the object-glass represented in the ninth figure, is to be considered as strictly just, when, in the fluid employed, the metallic particles are so far diminished, and the particles of marine acid so far increased, as to render the refraction of the several orders of rays proportional in both mediums.

I HAVE got an object-glass of this kind, which is represented in the twentieth figure. There are two refractions in the confine of glass and the fluid, but not the least colour whatever. Hence it is manifest that in the refraction which takes place in the confine of glass and this fluid, and which, on account of the difference of their densities, is very considerable, there is no unequal refrangibility of light. The rays of different colours are bent from their rectilineal course with the same equality and regularity as in reflection.

As custom has already appropriated the word *achromatic* to that kind of refraction in which there is only a partial correction of colour, in order to avoid confusion, I shall beg permission to distinguish this entire removal of aberration by the term *aplanatic* *, till a better can be thought of.

BEFORE closing this enquiry concerning the optical properties of transparent substances, I examined more minutely than I had done before, the qualities of the other mineral acids. The nitrous acid, when of the same mean refractive density as

the

* From the Greek *a* privative, and the verb *πλανάω*.

the marine acid, does not disperse the red and violet rays quite so much. The green ray, as in the marine acid, is found among the more refrangible rays; but it approaches nearer to the place of the mean refrangible ray in the nitrous acid than in the marine. The green ray is also nearer to the place of the mean refrangible ray, than it is in essential oils or in saturated metallic solutions; and therefore the nitrous acid appears by these experiments to disperse the several orders of rays more nearly in the same proportion in which crown-glass does, than any uncompounded dispersive medium, and would, I have no doubt, do so exactly, if slightly impregnated with mercury, though this I have not tried.

THE vitriolic acid is scarcely to be classed among dispersive mediums. The following experiment is the last I made on the subject. In a very good object-glass, of that kind before described, in which spirit of wine is one of the mediums employed, I substituted successively for this spirit the vitriolic acid and a solution of fixed alkaline salt, both of them of nearly the same mean refractive density as the spirit of wine. These three fluids, although they differ so widely in their chemical properties, have their optical properties so nearly alike, that I found it difficult to determine which was the medium employed. For when the secondary colour is not corrected, as was the case in this object-glass, the change of colour produced in the green and purple fringes to render it apparent, must be considerable, a slight shade of difference not being easily distinguishable. I therefore repeated the trial with an object-glass, in which this green and purple light is totally removed; and then both the vitriolic acid, and the solution of fixed alkali, when of equal mean refractive density with spirit of wine, appeared very sensibly more dispersive than the spirit. The difference in this respect between the acid and the alkali was scarcely to be distinguished; and the effect of a solution of caustic alkali appeared to be nearly the same as that of mild alkali

alkali of equal density. By similar trials, the phosphoric and acetous acids were found to be considerably more dispersive than spirit of wine.

ALTHOUGH these experiments with compound object-glasses of very large apertures, afford both the readiest and most accurate method of investigating the optical properties of refracting mediums, it would be both amusing and instructive to repeat them with compound prisms. I could have wished in particular, had my present situation been convenient for the purpose, to have taken the dimensions of the secondary spectrum, under given angles of incidence and refraction. For by comparing these with the dimensions of the primary spectrum, accurately ascertained by Sir ISAAC NEWTON, the degree of superiority of an object-glass composed of crown and flint-glass, over a simple object-glass, and of one in which there is a regular refraction of all the rays, over both, might be ascertained. At present, I can only state the circumstances of a comparison I made between two compound object-glasses of equal apertures, but very unequal lengths. One was composed of crown-glass, spirit of wine and an essential oil. The focal length is about fourteen inches, and the aperture two inches. The other object-glass was of crown and flint-glass; its focal length thirty-two inches, and its aperture two inches. I had it for a good one of its kind, and upon examination found no particular defect in its structure.

THE short telescope has a manifest advantage in the night, especially in viewing fine objects, such as double stars of inferior magnitudes, where the uncorrected colour is less hurtful.

BUT I was surprised, on viewing an object in bright sunshine, to find considerably more of that mistiness which arises from the unequal refrangibility of light, than appeared in the long telescope. I therefore diminished the aperture of the short one to one inch and a half, and comparing them again, there appeared no more of this mist in the one than in the other.

other. I farther reduced the aperture of the short one to one inch, when it became manifestly clearer than the long one, though, upon examining the coloured fringes, by covering half the object-glass, they still appeared of such a breadth as must necessarily hurt the distinctness.

I HAVE here given the result of this experiment as I find it noted down. Being made with no view to the determination of the point in question, the accuracy necessary for that purpose was not observed. It would appear, however, from this gross and indirect trial, that the aberration from unequal refrangibility would not differ very materially in these object-glasses, supposing their apertures and focal distances to be equal; though in one the partial correction of colour is effected by a combination of flint-glass and crown-glass, and in the other by a combination of crown-glass and spirit of wine, with an essential oil. If this aberration were exactly equal in both combinations, the misty indistinctness proceeding from it ought to be the same in both object-glasses, when the apertures and magnifying powers applied, are as the square roots of their respective focal lengths.

IT would appear that the aperture of an object-glass, composed of crown and flint-glass of thirty-two inches in focal length, ought not to exceed two inches, and therefore that three inches is too large an aperture for one of forty-two inches focal length; for the lengths in these two cases ought to be as four to nine. In some telescopes of this latter kind, I have observed a great deal of uncorrected colour, which prevents them from bearing magnifying powers, in proportion to the aperture of the object-glass. It is indeed but seldom that the union of the differently refrangible rays is so perfect as the construction admits. I have met with others in which the real aperture is so far contracted, by diaphragms placed within the tube, as scarcely to exceed two inches.

FROM

FROM inspecting the tables of the lengths and apertures of telescopes with simple object-glasses, it will appear, that the required length for an aperture of two inches is about thirteen feet. This exceeds two feet and an half, the length given to an achromatic telescope, whose object-glass is two inches in diameter, between five and six times. The length of the standard Hugenian telescope, whose aperture is three inches, is thirty feet. This is between eight and nine times the length of an achromatic telescope, the aperture of which is likewise three inches, and its length three and a half feet. But if the aberration from unequal refrangibility be diminished to the same degree as in the thirty inch telescope, the length must be increased, from three and a half feet to about five and a half. For its length must be to thirty inches, the length of the two inch aperture, as the square of two to the square of three; and then the telescope with the simple object-glass will only exceed it in length between five and six times as before.

THE observations which have been mentioned put it beyond a doubt, that the limit to the apertures and magnifying powers of what have been improperly called achromatic telescopes, is the very same which limits the performance of telescopes with simple object-glasses, namely, the unequal refrangibility of light; and it would seem, that the aberration from this cause may be diminished, by a combination of lenses of crown and flint glass, between five and six times.

Sir ISAAC NEWTON, by accurate experiments, hath determined the diameter of the least circular space within which parallel rays of all kinds can be collected by a simple lens, to be one fifty-fifth part of the diameter of the aperture of the lens. If the aberration, from unequal refrangibility in a compound object-glass, vitiates the distinctness less than in a simple object-glass, in the proportion of one to six, it may seem a reasonable conclusion, that the least circular space within which parallel rays of all kinds can be gathered by an object-glass composed

of crown and flint glass, ought to be one sixth of one fifty-fifth part of its aperture. The difference in the focal lengths of the eye-glasses will then render the indistinctness nearly equal in the two kinds of object-glasses with equal magnifying powers, in all cases where their apertures are equal, and their lengths as one to six.

THERE is, however, a circumstance of the greatest moment to be taken into account before this conclusion can be admitted, which is, that not merely the diameter of the circle of aberration is to be considered, but also the spissitude of the rays, both within that circle in general, and at different distances from its centre. The rarity of the light in the simple spectrum is such, that the aberration hurts much less than might be expected. But in the secondary spectrum, as two orders of coloured light are united, the imperfect union of the rays by the compound object-glass, will hurt the distinctness much more, in proportion to the extreme divergency.

ON this account, it is to be expected, that the proportional lengths of the spectrums, when the experiment comes to be properly made, will turn out less than as one to six, notwithstanding the degree in which the distinctness is hurt in the two kinds of telescopes, from the unequal refrangibility of light, may be nearly in that proportion.

THE principal improvement of refracting telescopes, pointed out by the preceding experiments, consists in an entire removal of this aberration from the unequal refrangibility of light. It appears from the performance of the small telescope above mentioned, in which the secondary colour is not removed, that considerable advantages may also be expected from substituting a more perfect medium for flint-glass; from a more perfect correction of the aberration from the spherical figure; from preventing that loss of light by reflection, which takes place when light enters into, or emerges from dense mediums surrounded

with air ; and from diminishing those errors which arise from faults in the workmanship.

THE disadvantages under which reflecting telescopes labour, arise from their requiring larger apertures to transmit the same quantity of light ; from being found to be more affected by imperfections of the atmosphere than refracting telescopes, and being liable to tarnish ; but principally from imperfections in the workmanship of the object speculum hurting their performance much more than equal imperfections in the object-glass hurt refractors.

THE deviation of a ray from its intended course, occasioned by an imperfection in the figure of a reflecting speculum, is to its deviation, arising from an equal imperfection in a lens, as four to one, when the ray passes from glass into air, and in the proportion of six to one, when it passes from air into glass. At a medium, therefore, it may be stated as five to one. It follows from hence, that supposing all other causes of imperfection removed but this of workmanship, and that the metal of speculums were capable of as good a polish as glass, and of reflecting as much light as glass transmits, still the perfection of the images of objects formed by refraction would greatly exceed those by reflection.

SUCH is the case in the refractions which take place in the confine of glass and air. But in the refractions made in the confine of glass, and mediums of greater density than air, the difference is still much greater.

THE proportion of the sine of the angle of incidence to the sine of the angle of refraction of a ray, in passing out of one medium into another medium, is composed of the proportion of the sine of the angle of incidence to the sine of the angle of refraction out of the first medium into any third medium, and of the proportion of the sine of the angle of incidence to the sine of the angle of refraction, out of that third medium into the second medium.

THUS, if the sine of the angle of incidence of any ray, in passing out of glass into air, be to the sine of its angle of refraction as twenty to thirty-one, and the sine of the angle of incidence of the same ray, in passing from air into oil of turpentine, be to the sine of its angle of refraction as twenty-five to seventeen, the proportion of the sine of the angle of incidence of that ray, to the sine of its angle of refraction, in passing out of glass into oil of turpentine, will be as five hundred to five hundred and twenty-seven.

HENCE the point to which light is converged by the refraction of a spherical segment of glass, surrounded with oil of turpentine, will be found to be above eighteen semi-diameters of the sphere from the apex of the lens, when light passes from oil of turpentine into glass, and seventeen semi-diameters of the sphere distant from the spherical segment, when light passes from glass into oil of turpentine; whereas in glass surrounded by air, the focal distance in these two cases is only two semi-diameters, and three semi-diameters; and when light is converged to a point by a concave reflecting speculum, the focal distance is only half a semi-diameter of the sphere to which the speculum is ground concave. Now, in all these cases, the errors of the rays arising from imperfections in the workmanship of object-glasses, or object-speculums, are as the focal distances to the radii of convexity; so that what Sir ISAAC NEWTON mentions, of his having nearly despaired of reflecting telescopes from this consideration, need not be wondered at.

THE great pains, however, which he took with his own hands, and the ingenious methods which he suggested, and which have been so ably prosecuted since his time, have gone farther than could be expected towards obviating this fundamental fault of reflectors. Whatever can be performed by reflection, may be expected from the long experience and indefatigable exertions of DR. HERSCHEL, aided by the countenance

nance and liberal support of the Royal Founder of our Society, the general Patron of Science.

I APPREHEND there is a cause which will render short telescopes always more distinct than long ones, where all other circumstances are, as nearly as possible, alike; and that it has operated in favour of reflecting telescopes. It is well known that gross bodies act on light at a distance. Some phenomena I have observed, appear to me to put it beyond doubt, that light also acts upon light, in such a way as to propagate this action of gross bodies much farther than is imagined. But I must delay entering farther on this subject; and shall only observe, that it was principally with an eye to this circumstance, that I endeavoured in my attempts to execute object-glasses on the above principles, to strain the increase of aperture to the utmost.

IT will be understood, that when the aberrations from the difference of refrangibility of light, and from the spherical figures of lenses are removed, there remains no farther limit to shortening telescopes, excepting from the requisite depth of the spheres and thickness of the glasses.

I FIND that in small object-glasses of about nine inches focal length, the aperture may be increased as far as three inches, and hardly beyond this, on account of the quick increase of depth of the spherical surfaces, and thickness of the glass. From the difficulty found in procuring good glass of sufficient thickness, it may perhaps be better to make the aperture for common purposes less than this. I shall therefore state it at two inches. Hence the lengths necessary for increased apertures may readily be found, as the increase of length is in the same ratio as the increase of aperture, a double aperture requiring a double length, and so forth. These lengths and apertures may be compared with the lengths and apertures necessary in single lenses, and in different kinds of reflectors, by the common tables.

IT appears from the preceding experiments, that in compound object-glasses of crown and flint-glass, there is only a partial correction of the aberration from unequal refrangibility, and therefore in them, and others of that kind, the apertures and magnifying powers must only be increased in a sub-duplicate ratio of the increase of length, as in single lenses.

I WILL not pretend to state with absolute certainty the precise aperture which an achromatic telescope of a given length ought to have. This must be determined by experience. If two inches be taken for the greatest aperture which ought to be given to a telescope of this kind two and thirty inches long, then three inches will be too much for one of forty-two inches, as hath been already observed. But whichever of these lengths and apertures be taken as the standard, it is certain, that if we would avoid a greater degree of that indistinctness which is occasioned by the aberration from difference of refrangibility, the aperture and magnifying power must not be increased in a greater proportion than the square root of the increased length. Besides, therefore, that this imperfect correction renders such telescopes incapable of bearing high magnifying powers for those of moderate lengths, large instruments, if they were to be attempted, would still be unmanageable, on account of their immoderate lengths. The focal length of an object-glass of this kind, four feet in diameter, would require to be upwards of fifteen hundred feet, in order to enable it to bear the magnifying power adapted to that aperture, with the same distinctness that is found in an object-glass two inches in diameter, and thirty-two inches in focal length. But when the aberration from difference of refrangibility is totally removed, the focal length of an object-glass four feet in diameter, need not exceed twenty feet.

HAVING mentioned to some friends the imperfect correction of the aberration from difference of refrangibility, which is obtained by the common combination of two mediums which differ

differ in dispersive power, I was informed, that something of the same kind had been observed by some foreign philosophers, and in particular by the celebrated M. CLAIRAUT and M. BOSCOVICH.

THE observation of the former appears in a Memoir of the French Academy of Sciences, of so old a date as the year 1757. As the passage relating to this subject is short, and does great credit to the author, as an accurate observer of the results of experiments, I shall beg permission to transcribe it. " Il y a en-
" core un fait important que nos experiences nous ont appris,
" c'est que les corrections des iris faites par les prismes combi-
" nés, ne sont jamais aussi parfaites qu'on le croiroit d'après
" les termes de M. DOLLOND. Dans le cas du prisme de verre
" placé dans l'eau; par example, après avoir fait varier les
" plaques qui determinent l'angle du prisme d'eau, jusqu'au
" point où les objects vus à travers les deux prismes, ne paroif-
" sent point décolorés, du moins aux vues ordinaires, on trouve
" en plaçant ces prismes dans la chambre noire, qu'il reste tou-
" jours quelque petit limbe de couleur vers les bordes de
" l'image du soleil, ce qui vient sans doute de ce que les par-
" ties du spectre que chaque matière réfringente donne, ne sont
" pas exactement proportionnelles aux longueurs totales de ces
" spectres. Mais ces inégalités qui diminuent à mesure que
" les angles des prismes sont plus petits, doivent être comme
" insensibles dans le cas des lentilles adossées, vu la petiteur des
" angles de refringence qui ont lieu alors." I shall only re-
mark on this passage, that M. CLAIRAUT would have observed
the uncorrected colour better, if he had made use of a much
smaller pencil of light than he appears to have done, and would
not have concluded so hastily, that this uncorrected aberration
was of little consequence to the performance of telescopes, if he
had recollectcd, that the smallness of the angles of the lenses is
greatly overbalanced by the magnifying power of the eye-
glaſs.

M:

M. BOSCOVICH formed an hypothesis concerning a perfect correction of colour, by a combination of mediums, which appears to have greatly misled him. As a combination of two mediums is necessary to unite two of the unequally refrangible rays, he imagines three mediums necessary to unite three, four to unite four, and, in short, that to effect a perfect union of the rays of the spectrum, as many mediums are required as there are unequally refrangible rays composing it, that is to say, an indefinite number. He supposes, however, than an union of three of the rays only, by means of three mediums, would greatly improve telescopes. This author seems to have founded his hypothesis on the same kind of loose analogical reasoning, which had before led the celebrated EULER into a similar mistake.

THE eye is composed of three humours and several coats; and M. BOSCOVICH takes it for granted, that a more perfect union of the rays than what takes place in a combination of crown and flint glass, is effected by their means. But this is a supposition very remote from the truth indeed. So far is this secondary colour from being corrected in the human eye, that in the construction of this admirable organ, it hath been deemed unnecessary to introduce any contrivance for the correction of the Newtonian aberration. *Natura nihil agit frustra.* The perfection of the Contriver equally appears from a manifestation of his power, and of his œconomical exertion of that power. On account of the shortness of the focal distance of the humours of the eye, in proportion to the aperture of the pupil, the aberration from the spherical figure would be enormous; and we find it obviated by the very elaborate artifice of rendering the crystalline humour more dense towards the centre. The aberration from difference of refrangibility might have been removed, by imparting a proper degree of dispersive power to the vitreous humour. But this, being unnecessary for the common purposes of life, is withheld.

Dr

Dr MASKELYNE has taken the pains to compute the quantity of this aberration in the eye, and is of opinion that it is not incompatible with distinct vision *. But as it has been just asserted as a matter of fact, that the aberration from difference of refrangibility is not corrected in the human eye, it will be expected that the proofs on which this assertion is founded, should be explained. These are so ample as to leave no cause of uncertainty ; nor are the necessary experiments attended with much trouble. For it happens that the humours are better placed for the purpose in the natural eye, than art could dispose them elsewhere.

WHEN I take the penknife which now lies before me, and hold it between me and the sky, at the distance to which the eye is conformed for distinct vision, the blade appears distinct, and well defined. If the eye be now accommodated to a more distant object, the blade of the knife begins to be surrounded with a penumbra ; and if this penumbra be carefully attended to, it appears to be coloured, and the colour next to the knife is red inclining to orange, which is the colour of the least refrangible rays.

IF the eye be again accommodated to the distance necessary for seeing the knife distinctly, the bars of the window, which is at a greater distance than the knife, are surrounded with a penumbra, and the colour of this penumbra is blue, which is the prevailing colour of the most refrangible rays. The same appearances will be observed in all cases where the confine of a dark and luminous object is carefully examined, and will be so much the more conspicuous by how much the contrast of light and darkness is stronger. It requires, however, a capacity of viewing with attention an object to which the eye is not conformed, which must be acquired by habit. The following easy experiment may be tried by any one. Shutting one eye, observe with the other the four well defined black pa-

* Philosophical Transactions of London, Vol. lxxix. p. 256.

rallel lines which denote four o'clock in the enamelled dial-plate of a watch, and make the watch approach the eye very slowly. So long as the eye can conform itself to the distance, the black lines will appear distinct and of their proper colours. But when the watch, continuing to approach, is brought too near for the eye, by any effort, to see the lines distinctly, the coloured fringes will begin to make their appearance, and the spreading of the less refrangible rays into the black strokes, and the more refrangible rays into the white intervals, will make them appear to change their colours from black and white to orange and blue.

If any doubt should remain concerning the prismatic colour produced by the refraction of the humours of the eye, let the observer look at a bar of the window, where it is opposed to the sky, and holding his hand parallel with the bar, bring it slowly over his eye, he will observe, just before the bar disappears, one side of it edged with red inclining to orange, and the other with blue, and these colours in as great quantity as would be produced by a prism of a pretty considerable refracting angle. The application of these observations to what was before said of the fringes of colour produced by simple and compound lenses, is obvious. If the aberration from difference of refrangibility were perfectly corrected, no colour whatever would appear, either in the penumbras, or on covering part of the pupil. Had this been effected, it is probable that the vitreous humour would be found sufficiently dispersive to correct the colour produced by the aqueous and crystalline humours, and that the ratio in which it separated the rays which form the coloured spectrum, would be the same as in them. Such a colourless refraction might then be produced as has been found to arise from a combination of crown-glass with a fluid medium, containing a due proportion of metallic particles and particles of marine acid.

If

IF the coloured penumbras, instead of being red when the eye is conformed to a greater distance than that of the object observed, and blue when conformed to a less distance, had been purple in the former case, and green in the latter, it would be reasonable to conclude, that the vitreous humour was a dispersive medium of the same kind with essential oils, and such as owe this property to metalline particles with which they are impregnated.

BUT if the purple fringe had appeared round the object, when the eye is conformed to too small a distance for seeing it distinctly, and with a green fringe under the contrary circumstances, this would indicate a dispersive power in the vitreous humour, similar to that of the muriatic acid.

IN some animals, and particularly in birds of prey, the images of objects on the retina are required to be more perfect than in the human eye. It would be an object of some moment in comparative physiology, to determine whether there be any partial or total correction of aberration from the difference of refrangibility in the eyes of these animals, which, if found necessary, will without doubt be the case. In some experiments which I once attempted with the vitreous humour, I found irregularities arise in the refraction, from giving it a figure different from its natural one. Possibly such difficulties might be obviated by diluting the humours with some mild fluid of known optical properties.

THE aberration from unequal refrangibility not being corrected in the eye, is one cause why vision through a good telescope is more perfect, independent of magnifying power, than naked vision when most perfect; a fact which must appear so extraordinary, that it can scarcely be expected to be credited, except by those who have convinced themselves of it by experience.

IN order to explain this, it must be observed, that the ultimate effect required to be produced by a telescope or microscope,

is not a perfect union of the rays at the focus of the object-glass, but at the retina. This is to be effected by so disposing the rays at their emergence from the eye-glass, that the humours of the eye shall accurately converge each of the pencils to one point of the retina. If we conceive a point of the retina to become a radiant point whence the rays issue, the rays of different colours, at their emergence from the cornea, will be inclined to each other in a certain degree, on account of their unequal refrangibility, and will continue to diverge, till they arrive, we shall suppose, at the eye-glass. Now, this is exactly the state in which rays emerging from the eye-glass, and tending towards the eye, ought to be, in order to insure their perfect union at that point of the retina from which the above mentioned rays were supposed to radiate.

ANOTHER cause which operates in favour of telescopic vision, is the smallness of the pencil where it enters the eye. When the diameter of the pencil is equal to that of the pupil, the rays, in passing the edge of the iris, are inflected, that is to say, they are made to deviate from their rectilineal course, some of them being bent towards the iris, and others from it, and thus throw a scattered light round the image on the retina. The radiation of the bright fixed stars proceeds partly from this cause. This source of indistinctness is totally removed in a telescope, where the diameter of the pencil, at its entrance into the eye, is so much less than the pupil, that none of the rays pass near enough the iris to suffer any inflection. The size of the pencil must not, however, be diminished too far; for if this is done beyond a certain degree, the distinctness will be quite destroyed, as was first observed by HUGENIUS.

I SHALL now recapitulate, and present in one view, the contents and scope of this discourse.

THE unequal refrangibility of light, as discovered and fully explained by Sir ISAAC NEWTON, so far stands its ground uncontroverted,

controverted, that when the refraction is made in the confine of any medium whatever, and a vacuum, the rays of different colours are unequally refracted, the red-making rays being the least refrangible, and the violet-making rays the most refrangible.

THE discovery of what has been called a different dispersive power in different refractive mediums, proves those theorems of Sir ISAAC NEWTON not to be universal, in which he concludes that the difference of refraction of the most and least refrangible rays, is always in a given proportion to the refraction of the mean refrangible ray. There can be no doubt that this position is true with respect to the mediums on which he made his experiments; but there are many exceptions to it.

FOR the experiments of Mr DOLLOND prove, that the difference of refraction between the red and violet rays, in proportion to the refraction of the whole pencil, is greater in some kinds of glass than in water, and greater in flint-glass than in crown-glass.

THE first set of experiments above recited, prove, that the quality of dispersing the rays in a greater degree than crown-glass, is not confined to a few mediums, but is possessed by a great variety of fluids, and by some of these in a most extraordinary degree. Solutions of metals, essential oils, and mineral acids, with the exception of the vitriolic, are most remarkable in this respect.

SOME consequences of the combinations of mediums of different dispersive powers, which have not been sufficiently attended to, are then explained. Although the greater refrangibility of the violet rays than of the red rays, when light passes from any medium whatever into a vacuum, may be considered as a law of nature; yet in the passage of light from one medium into another, it depends entirely on the qualities of the mediums, which of these rays shall be the most refrangible, or whether there shall be any difference in their refrangibility.

THE

THE application of the demonstrations of HUGENIUS to the correction of the aberration from the spherical figures of lenses, whether solid or fluid, is then taken notice of, as being the next step towards perfecting the theory of telescopes.

NEXT it appears from trials made with object-glasses of very large apertures, in which both aberrations are corrected as far as the principles will admit, that the correction of colour which is obtained by the common combination of two mediums which differ in dispersive power, is not complete. The homogeneous green rays emerge most refracted, next to these the united blue and yellow, then the indigo and orange united, and lastly the united violet and red, which are least refracted.

If this production of colour were constant, and the length of the secondary spectrum were the same in all combinations of mediums when the whole refraction of the pencil is equal, the perfect correction of the aberration from difference of refrangibility would be impossible, and would remain an insurmountable obstacle to the improvement of dioptrical instruments.

THE object of the next experiments is, therefore, to search, whether nature affords mediums which differ in the degree in which they disperse the rays composing the prismatic spectrum, and at the same time separate the several orders of rays in the same proportion. For if such could be found, the above mentioned secondary spectrum would vanish, and the aberration from difference of refrangibility might be removed. The result of this investigation was unsuccessful with respect to its principal object. In every combination that was tried, the same kind of uncorrected colour was observed, and it was thence concluded, that there was no direct method of removing the aberration.

BUT it appeared in the course of the experiments, that the breadth of the secondary spectrum was less in some combinations than in others, and thence an indirect way opened, leading to the correction sought after; namely, by forming a compound

pound concave lens of the materials which produce most colour, and combining it with a compound convex lens formed of the materials which produce least colour ; and it was observed in what manner this might be effected by means of three mediums, though apparently four are required.

IN searching for mediums best adapted for the above purpose, a very singular and important quality was detected in the muriatic acid. In all the dispersive mediums hitherto examined, the green rays, which are the mean refrangible in crown-glass, were found among the less refrangible, and thence occasion the uncorrected colour which has been described. In the muriatic acid, on the contrary, these same rays make a part of the more refrangible ; and in consequence of this, the order of the colours in the secondary spectrum, formed by a combination of crown-glass with this fluid, is inverted, the homogeneal green being now the least refrangible, and the united red and violet the most refrangible.

THIS remarkable quality found in the marine acid led to complete success in removing the great defect of optical instruments, that dissipation or aberration of the rays, arising from their unequal refrangibility, which has rendered it impossible hitherto to converge all of them to one point, either by single or opposite refractions. A fluid in which the particles of marine acid and metalline particles hold a due proportion, at the same time that it separates the extreme rays of the spectrum much more than crown-glass, refracts all the orders of rays exactly in the same proportion as the glass does ; and hence rays of all colours, made to diverge by the refraction of the glass, may either be rendered parallel by a subsequent refraction made in the confine of the glass and this fluid, or by weakening the refractive density of the fluid, the refraction which takes place in the confine of it and glass, may be rendered as regular as reflection, while the errors arising from unavoidable imperfections of workmanship, are far less hurtful than in reflection,

and

and the quantity of light transmitted by equal apertures of the telescopes much greater.

SUCH are the advantages which the theory presents. In reducing this theory to practice, difficulties must be expected in the first attempts. Many of these it was necessary to surmount before the experiments could be completed. For the delicacy of the observations is such, as to require a considerable degree of perfection in the execution of the object-glasses, in order to admit of the phenomena being rendered more apparent by means of high magnifying powers. Great pains seem to have been taken by mathematicians to little purpose in calculating the radii of the spheres requisite for achromatic telescopes, from their not considering that the object-glass itself is a much nicer test of the optical properties of refracting mediums than the gross experiments made by prisms, and that the results of their demonstrations cannot exceed the accuracy of the data, however much they may fall short of it.

I SHALL conclude this paper, which has now greatly exceeded its intended bounds, by enumerating the several cases of unequal refrangibility of light, that their varieties may at once be clearly apprehended.

IN the refraction which takes place in the confine of every known medium and a vacuum, rays of different colours are unequally refrangible, and the red-making rays are least refrangible, and the violet-making rays are most refrangible.

THIS difference of refrangibility of the red and violet rays is not the same in all mediums. Those mediums in which the difference is greatest, and which, by consequence, separate or disperse the rays of different colours most, have been distinguished by the term *dispersive*, and those mediums which separate the rays least have been called *indispersive*. Dispersive mediums differ from indispersive, and still more from each other, in another very essential circumstance.



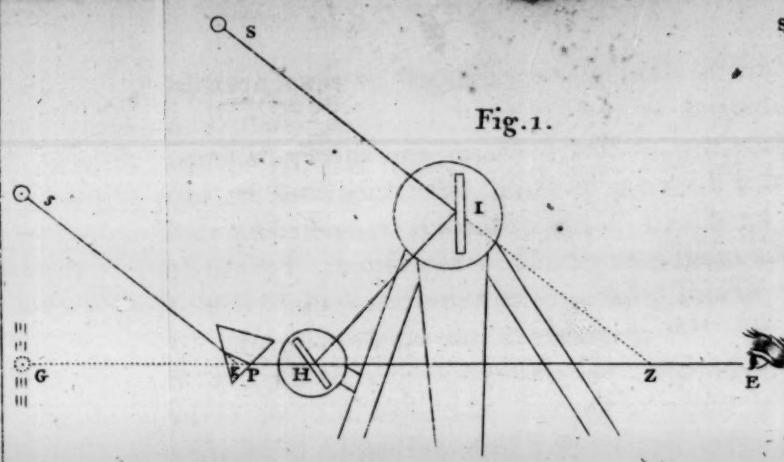


Fig. 1.

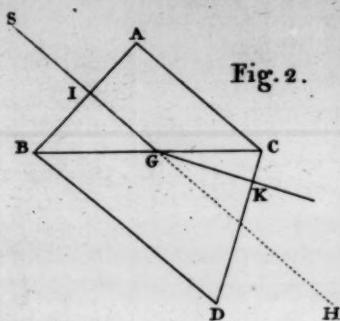


Fig. 2.

Fig. 3.

Red. Green. Violet.

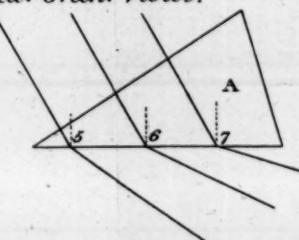


Fig. 4.

Red. Green. Violet.

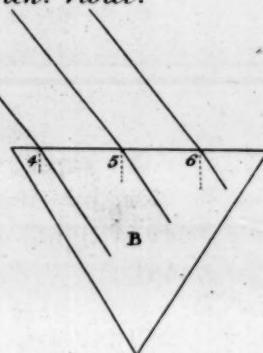


Fig. 5.

Red. Green. Violet.

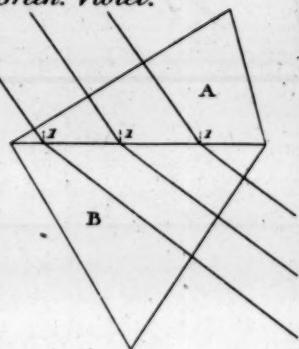


Fig. 6.

Red. Green. Violet.

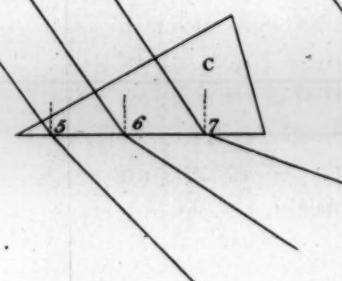


Fig. 7.

Red. Green. Violet.

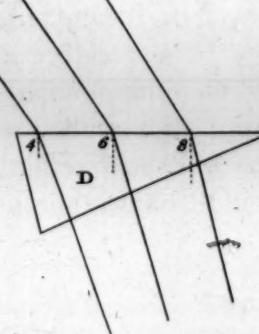
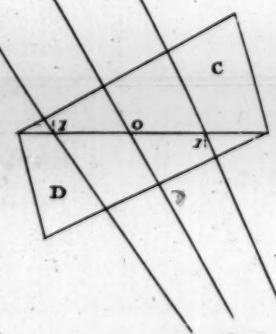


Fig. 8.

Red. Green. Violet.



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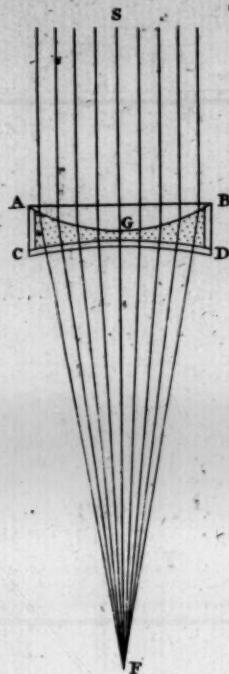


Fig. 9.

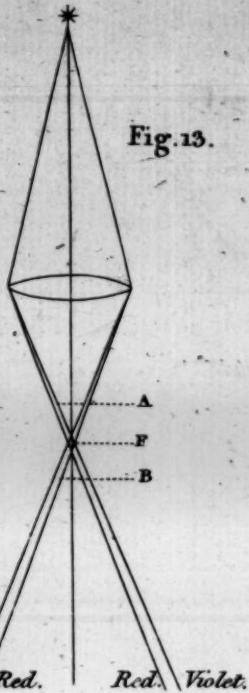


Fig. 13.

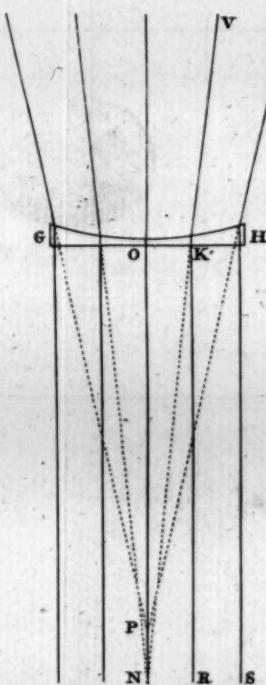


Fig. 11.

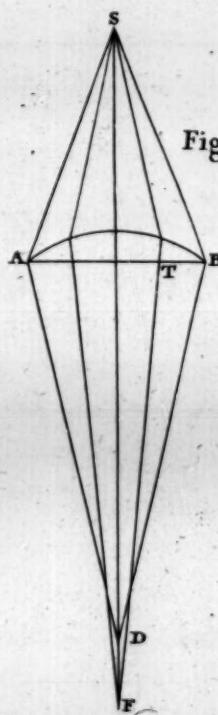


Fig. 10.

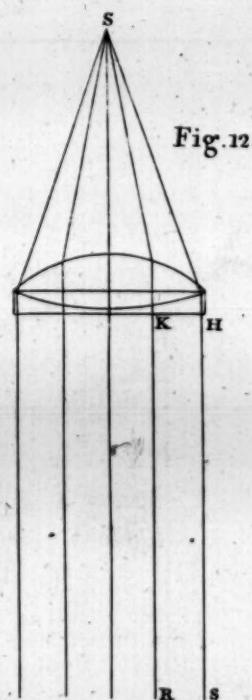


Fig. 12.

Fig. 20.

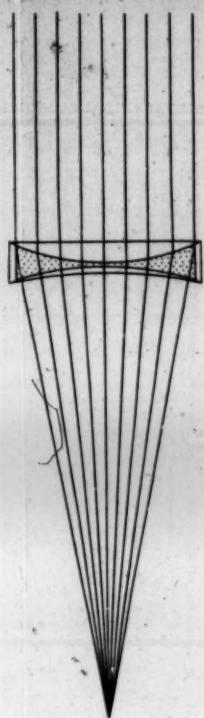


Fig. 14.

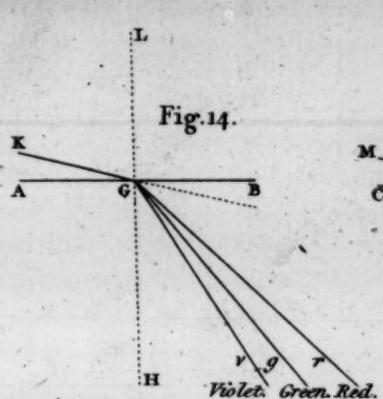


Fig. 15.

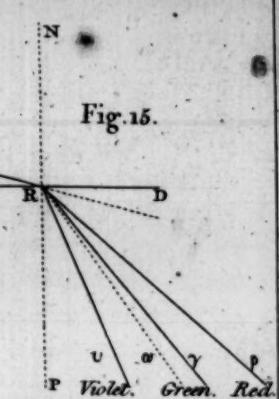


Fig. 16.

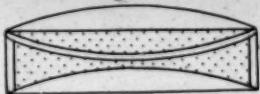


Fig. 17.

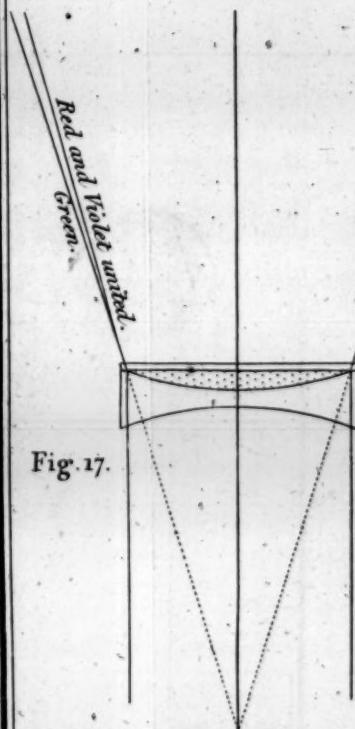


Fig. 18.

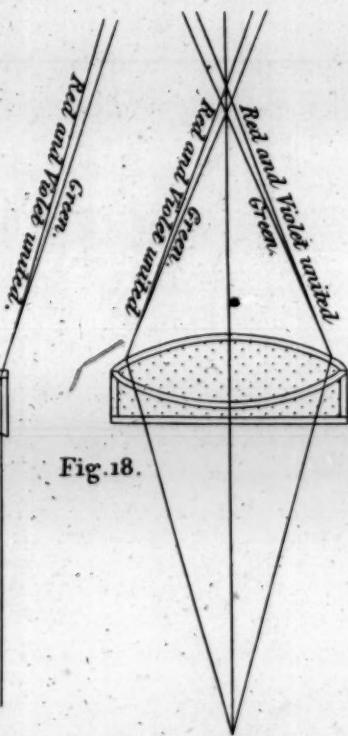
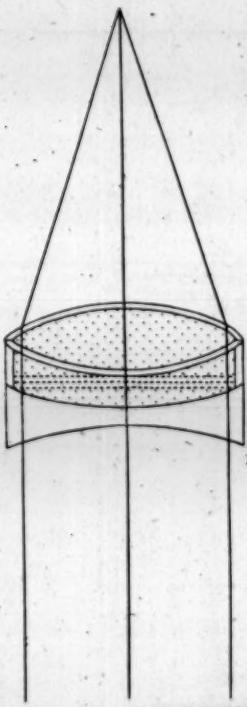
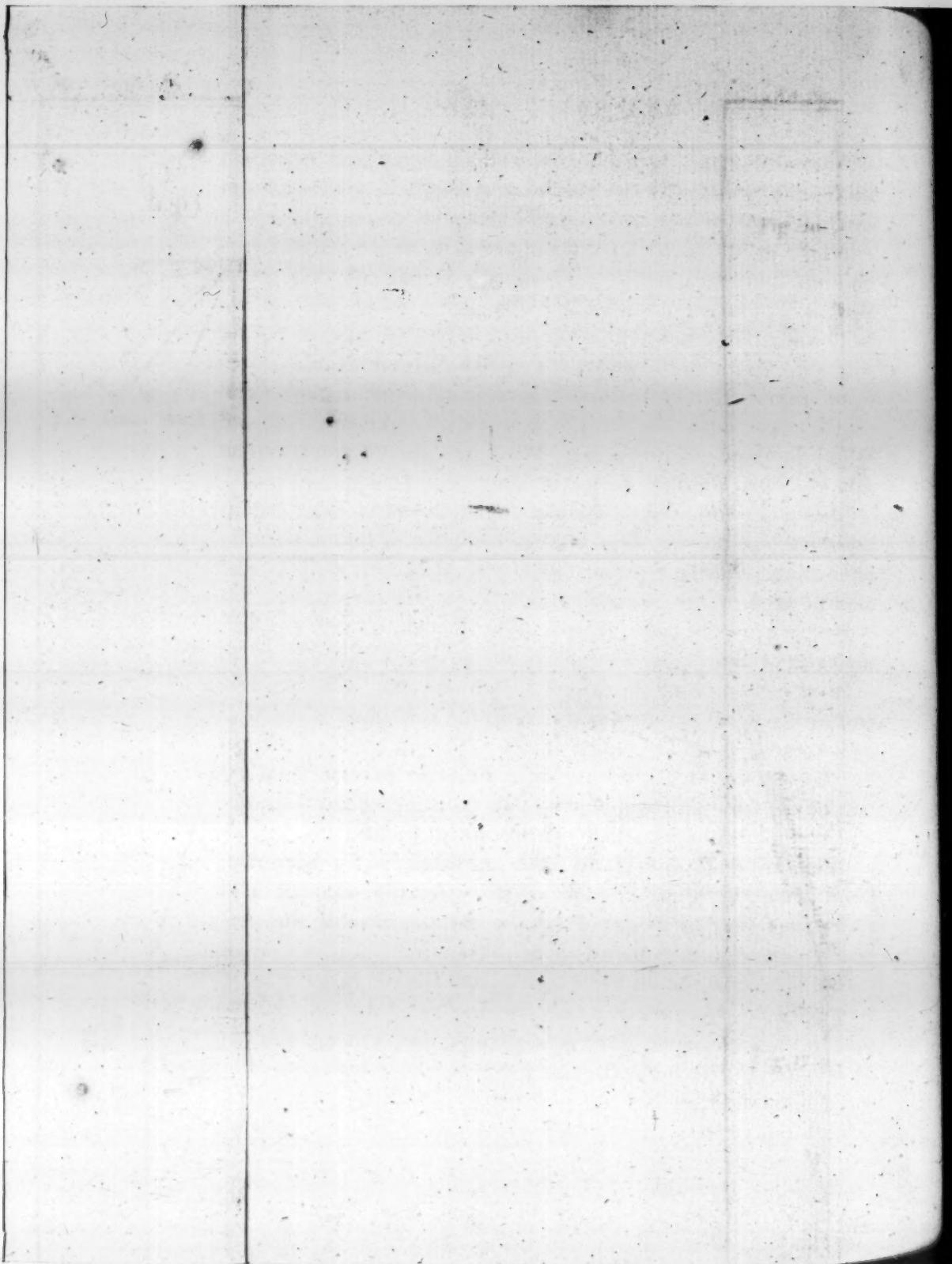


Fig. 19.





IT appears from the experiments which have been made on indispersive mediums, that the mean refrangible light is always the same, and of a green colour.

Now, in by far the largest class of dispersive mediums, including flint-glass, metallic solutions, essential oils, the green light is not the mean refrangible order, but forms one of the less refrangible orders of light, being found in the prismatic spectrum nearer to the deep red than the extreme violet.

IN another class of dispersive mediums, which includes the muriatic and nitrous acids, this same green light becomes one of the more refrangible orders, being now found nearer to the extreme violet than the deep red.

THESE are the varieties in the refrangibility of light, when the refraction takes place in the confine of a vacuum; and the phenomena will scarce differ sensibly in refractions made in the confine of dense mediums and air.

BUT when light passes from one dense medium into another, the cases of unequal refrangibility are more complicated.

IN refractions made in the confine of mediums which differ only in strength, not in quality, as in the confine of water and crown-glass, or in the confine of the different kinds of dispersive fluids more or less diluted, the difference of refrangibility will be the same as above stated in the confine of dense mediums and air, only the whole refraction will be less.

IN the confine of an indispersive medium, and a rarer medium belonging to either class of the dispersive, the red and violet rays may be rendered equally refrangible. If the dispersive power of the rare medium be then increased, the violet rays will become the least refrangible, and the red rays the most refrangible. If the mean refractive density of the two mediums be rendered equal, the red and violet rays will be refracted in opposite directions, the one towards, the other from the perpendicular.

THUS it happens to the red and violet rays, whichever class of dispersive mediums be employed. But the refrangibility of the intermediate orders of rays, and especially of the green rays, will be different when the class of dispersive mediums is changed.

THUS in the first case, where the red and violet rays are rendered equally refrangible, the green rays will emerge most refrangible, if the first class of dispersive mediums is used, and least refrangible if the second class is used. And in the other two cases, where the violet become least refrangible, and the red most refrangible, and where these two kinds of rays are refracted in opposite directions, the green rays will join the red, if the first class of dispersive mediums be employed, and will arrange themselves with the violet, if the second class be made use of.

ONLY one case more of unequal refrangibility remains to be stated; and that is, when light is refracted in the confine of mediums belonging to the two different classes of dispersive fluids. In its transition, for example, from an essential oil, or a metallic solution, into the muriatic acid, the refractive density of these fluids may be so adjusted, that the red and violet rays shall suffer no refraction in passing from the one into the other, how oblique soever their incidence be. But the green rays will then suffer a considerable refraction, and this refraction will be from the perpendicular, when light passes from the muriatic acid into the essential oil, and towards the perpendicular, when it passes from the essential oil into the muriatic acid. The other orders of rays will suffer similar refractions, which will be greatest in those adjoining the green, and will diminish as they approach the deep red on the one hand, and the extreme violet on the other, where the refraction ceases entirely.

THE manner of the production of these effects, by the attraction of the several mediums, may be thus explained.

WE

We shall suppose the attractive forces, which produce the refractions of the red, green and violet light, to be represented by the numbers eight, twelve and sixteen, in glass; six, nine, fourteen, in the metallic solution; six, eleven, fourteen, in the muriatic acid; and six, ten, fourteen, in a mixture of these two fluids. The excess of attraction of glass for the red and violet light is equal to two, whichever of the three fluids be employed. The refraction of these two orders of rays will therefore be the same in all the three cases. But the excess of attraction for the green light is equal to three, when the metallic solution is used, and therefore the green light will be more refracted than the red and violet, in this case. When the muriatic acid is used, the excess of attraction of glass for the green light is only one, and therefore the green light will now be less refracted than the red and violet. We shall next suppose the metallic solution and the acid to adjoin each other. The attractions of both these mediums, for the red light being six, and for the violet light fourteen, these two orders of rays will suffer no refraction in the confine of the two fluids, the difference of their attractions being equal to nothing.

BUT the attractive force of the metallic solution for the green ray being only nine, and that of the muriatic acid for the same ray being eleven, the green light will be attracted towards the muriatic acid with the force two; and therefore the difference between the refraction of the green light and the unrefracted red and violet light which takes place in the confine of these fluids, will greatly exceed the difference of refraction of the green light, and equally refracted red and violet light, which is produced in the confine of glass and either of the fluids.

LASTLY, in a mixture of the two kinds of fluids, the attraction for the red, green and violet rays, being six, ten and fourteen, and that of the glass, eight, twelve and sixteen, the excess of the attraction of the glass for the green rays, is the same

which it is for the red and violet rays. These three orders of rays will therefore suffer an equal refraction, being each of them attracted towards the glass with the force two; and when this is the case, it appears from the observations, that the indefinite variety of rays of intermediate colours and shades of colours, which altogether compose solar light, will also be regularly bent from their rectilinear course, constituting what has been termed *aplanatic refraction*.

THESE cases of attraction might be farther illustrated by means of diagrams. But after the explanation already given of the second, third, fourth, fifth, sixth, seventh and eighth figures, this would be unnecessary. And it need scarcely here be observed, that the above rough statements in round numbers, are intended to give a clear idea of the nature of the various cases of unequal refrangibility, and not to ascertain its quantity in any particular case. A full investigation of the subject, and an account of some digressions less immediately connected with the principal object which occurred in the course of the enquiry, could not be brought within the compass of the present communication.

II.

MAGAZINE

II. OBSERVATIONS on GRANITE.

By JAMES HUTTON, M. D.

F. R. S. EDIN. and Member of the Royal Academy of Agriculture at PARIS.

[Read Jan. 4. 1790.]

SINCE reading the paper upon the theory of the earth *, I have been employed in examining many parts of this country, in order to enquire into the natural history of granite. In this undertaking, I have succeeded beyond my most flattering expectations; and I am now to communicate to this Society the result of my observations.

In the paper just referred to, it was maintained, from many different arguments, that all the solid strata of the earth had been consolidated by means of subterraneous heat, softening the hard materials of those bodies; and that in many places, those consolidated strata had been broken and invaded by huge masses of fluid matter similar to lava, but, for the most part, perfectly distinguishable from it. Granite also was considered there as a body which had been certainly consolidated by heat; and which had, at least in some parts, been in the state of perfect fusion, and certain specimens were produced, from which I drew an argument in support of this conclusion.

At that time, however, I was not perfectly decided in my opinion concerning granite; whether it was to be considered as a body which had been originally stratified by the collection of its different materials, and afterwards consolidated by the fusion of

* Vid. Trans. R. S. Edin. vol. I. p. 209. Phys. Cl.

those materials; or whether it were not rather a body transfused from the subterraneous regions, and made to break and invade the strata, in the manner of our whinstone or trapp, and of porphyries, into which the whinstone often graduates.

IT was not that I doubted of there being such a thing as stratified granite; the *granit feuilleté* or *granit veiné*, which M. DE SAUSSURE has described in his *Voyages dans les Alpes*, is certainly a stratified granite; and this is very well distinguished by that author, as is the *granit en masse*, the history of which we are now enquiring after. I had also specimens of a similar veined granite from the North-west Highlands, that is, from beyond Fort William and the lakes; and this veined granite is stratified along with the quartzy, micaceous and Alpine strata.

BUT my object was to know if the granite that is found in masses has been made to flow in the bowels of the earth, in like manner as those great bodies of our whinstone and porphyry, which may be considered as subterranean lavas. Now, this question could only be determined by the examination of that species of granite upon the spot, or where it is to be found in immediate connection with those bodies which are evidently stratified; bodies, consequently, whose natural history we have some means of tracing.

IN stratified bodies, we have not only the means of distinguishing those which, in point of time or succession of operation, have been formed prior and posterior, we may also, with regard to the manner of operation, distinguish those stratified bodies from others which had been introduced among them in a forcible manner, or with marks of violence inconsistent with the regular process of stratification. Now, the evidence of this must be found in the broken, separated and distorted parts of those regularly formed bodies, the natural history of which we so far know.

THIS was the question, with regard to granite, that I wanted to have resolved by means of the connection of that mass with the

the Alpine strata ; that is to say, I wanted to see, whether the granite mass, in point of time, had been prior or posterior to these water-formed bodies ; and, as to the manner of operation, I particularly desired to know, if that granite had been made to flow, in the state of fusion, among the broken and dislocated strata.

HAVING thus suspended my opinion, until I should have an opportunity of finding some decisive appearance, by which this important question might be determined with certainty, I considered where it might be most likely to find the junction of the granite country with the Alpine strata. Mr CLERK of Eldin and I had an engagement to visit the Duke of ATHOL, at Blair. I concluded, that from Blair it could not be far before the great mass of granite, which runs south-west from Aberdeen, would be met with, in ascending the river Tilt, or some of its branches. Mr CLERK and I were, however, resolved to find it out, to whatever distance the pursuit might lead us among the mountains of this elevated track. Little did we imagine that we should be so fortunate as to meet with the object of our search almost upon the very spot where the Duke's hunting-seat is situate, and where we were entertained with the utmost hospitality and elegance.

IT is in Glen Tilt, and precisely in the bed of the river, that this junction is formed of the granite with the Alpine strata. But this circumstance, of being in the bed of the river, where the rocks are often washed bare, is of such importance, that had this junction been only to be found in the mountains covered with heath and moss, we might have been upon the spot, and yet been ignorant of the most material circumstances of the fact, which we wanted to explore.

I HERE had every satisfaction that it was possible to desire, having found the most perfect evidence, that the granite had been made to break the Alpine strata, and invade that country in a fluid state. This corresponded perfectly with the conclusion
which

which I had drawn from the singular specimen of the Portsoy granite*. ~~to 1786 and had come to a stop at about the same time~~

IT was in the year 1785, that we were thus gratified by a sight of the junction of the granite with the Alpine schiste, or primary strata, as they may be called, of the north country. We now were eager to see the junction of the granite country, which I knew to be at the head of Loch Dune, with the schistus strata of the south of Scotland. In the year 1786, therefore, Mr CLERK and I set out by the shire of Ayr, to search round the coast of Galloway, in order to find the junction of the granite mountains with the schistus or vertical strata, of which I knew that Galloway consisted.

WE were extremely fortunate in finding what we looked for, in two different places in Galloway; first, in the mountain of Cairn's muir, between two and three miles from the Ferry-town of Cree; and, secondly, in a little bay upon the sea-side, about mid-way between Covend and Saterness point on the Solway frith. Here we were as much satisfied, as we had been the year before, that the granite had invaded the schistus or Alpine strata, having not only broken and floated the schistus in every way possible, but in the last of those two places, we found the granite introduced, for some length, in small veins between the stratified bodies, giving every mark of the most fluid injection among the broken and distorted strata.

IN August 1787, I set out for Arran. Mr CLERK could not go at that time, and Mr JOHN CLERK, junior, was so kind as to accompany me. We had exceeding good weather for exploring the lofty mountains of that island, and returned extremely satisfied with our expedition.

I PROPOSE to give a particular account of the construction of Arran, or a mineralogical history of it; therefore it will here only be necessary to say, that I found my former conclusions fully confirmed by all the appearances in this most interesting island; and I brought specimens with me, some of them of great size,

* Trans. R. S. Edin. vol. I. p. 255. Phys. Cl.

size, which to every person who has seen them, leave no manner of doubt with regard to the proposition which I have maintained.

WE are now fully assured that granite has been made to break, displace and invade the Alpine schistus or primary strata having been previously forced to flow in the bowels of the earth, and reduced into a state of fusion. From this too we are to draw the following conclusion :

GRANITE, which has been hitherto considered by naturalists as being the original or primitive part of the earth, is now found to be posterior to the Alpine schistus ; which schistus, being stratified, is not itself original ; though it may be considered, perhaps, as primary, in relation to other strata, which are evidently of a later date.

THE successive operations of the globe, in producing, destroying and replacing strata, for the purpose of land, are a subject of natural history most interesting to every theory of the earth. The view of granite which has now been given, forms one great step in this enquiry ; and it is connected with some other very important facts with regard to the successions of strata, or a certain order of geological periods, which may be ascertained by the natural history of our minerals. Of this I shall also treat in another place ; and I wish what I now lay before the Society, to be considered merely as a notice given of certain new facts and observations, which I mean fully to describe and explain hereafter.

[Read Aug. 1. 1791.]

SINCE reading the mineralogical notice in this Society with regard to granite, I have found that the same curious appearance, which had occurred in the granite of Portsoy, (described in the first volume of these Transactions, and referred to above), has been observed in a very distant part of the world. In the Journal de Physique, Avril 1791, M. PATRIN describes a granite mountain in the eastern part of Siberia, where we meet with the following account:

" ENFIN, l'on trouve dans les parois de ce filon, cette espèce singulière de roche qu'on a nommée *pierre graphique*: c'est " un feld-spath dans lequel se trouvent une multitude de petits " cristaux quartzeux, tous à-peu-près du même volume, et " placés dans le même sens, avec une sorte de regularité. Ces " cristaux n'ont de quartz que la carcasse; l'intérieur est de " feld-spath: le plus souvent même il manque plusieurs faces " des cristaux; de manière que quand on coupe la pierre trans- " versalement, elle présente une suite de figures qui sont des " portions d'hexagones, ce qui ne ressemble pas mal à de l'écri- " ture. J'en ai un échantillon qui imite si bien les caractères " Hebraïques, que quelqu'un a dit en la voyant, que certaine- " ment c'étoit un morceau des tables de MOYSE.

" ON trouve la même pierre aux environs d'Ekaterinbourg, " dans les Monts Oural, qui fert également de lisière à un filon " de topases; ce qui me feroit soupçonner qu'elle est un indice " de cette gemme. J'ai vu à Paris, dans la belle collection de " M. BESSON, des échantillons de *pierre graphique*, venant de " Corse;

"Corse*; peut-être y trouvera-t-on quelque jour des to-pases."

M. PATRIN has represented this species of crystallization in a different light from that by which I had endeavoured to explain the appearance of this stone. He considers the quartz as crystallizing in its natural hexagonal shape, and thus including bodies of feld-spar; whereas I think that it is the sparry structure of the last that had induced a certain form upon the quartz, a form which is neither the natural shape of the crystallization of that siliceous substance, nor an accidental shape, that had arisen from preceding causes, but a shape determined by the concretion of this mixed body crystallizing from the fluid state of fusion. Indeed, I see nothing in the specimens which we possess, that can justify M. PATRIN's supposition; on the contrary, almost every appearance is inconsistent with it. I shall mention only one.

If the figuring cause, which proceeds longitudinally through the stone, were that of the siliceous crystallization, then the transverse section would exhibit hexagonal figures of quartz, inclosing bodies of feld-spar. Now, M. PATRIN says, that several of those sides of the hexagons are wanting; but then what remains should be conformable to that hexagonal figure of which it was a part. This, however, I think, is not the case; and in the specimens which I have, the rhombic angles of the feld-spar seem so prevalent in the figures, and these *Hebrew* or rather *Runic characters* are so regularly directed by two lines corresponding with the rhombic angle, that I cannot help ascribing this regular figure to that cause, and not considering it as produced by the obtuse angles of imperfect hexagons. It

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* I am inclined to believe that this Specimen, which is here represented as coming from Corfica, is no other than the granite of Portsoy which I have described. I imagine that here is only a graphic error, in writing *de Corfe*, in place of *d'Ecoffre*.

is true indeed that there are many of these angles obtuse ; but there are an equal number, which are as much less than the right-angle, as the others are greater.

IN whichever of these two lights we are to take the explanation of this mineral appearance, my argument, *viz.* that these two substances had concreted together from a fluid state of fusion, is equally supported. For whether crystallizing quartz shall inclose a body of feld-spar, or concreting feld-spar determine the shape of fluid quartz ; particularly, if we have, as is here also the case, two solid bodies mutually including and included by each other, it amounts to a demonstration, that those bodies had concreted from the fluid state of fusion, and had not crystalized in the manner of salts from a solution. Therefore, here is the testimony of granite from three different places of the earth, *viz.* from the Daouri, from the Oural Mountains, and from Scotland, by which this truth is manifested.

IT would seem that the circumstances, necessarily concurring in order to produce this particular effect, are rarely to be found ; and the external circumstances which attend it in the east, do not appear to accompany it in the west of Europe. In Scotland, this stone neither forms the walls of a vein, nor are topazes found connected with it, as M. PATRIN found it in the east. The internal circumstances, therefore, which, in the mass of granite, determine this particular construction of the stone, are to us unknown.

IT is not, however, confined to any particular place or situation ; it is found both at the level of the sea, and upon the highest parts of the earth, and in countries extremely distant from each other. Now, considering that nothing is more general in minerals than granite, it is surprising that this particular modification of its constituent parts has been so little observed. But, as it would seem to take place only in small portions of the granite mass, there may be similar examples in many masses, or in most granite

nite countries, without their having as yet appeared to the view of naturalists ; and I am persuaded, that many will be discovered, if it should be made an object for the enquiry of those who have the opportunity of examining this subject.

IV.

III. *Of the FLEXIBILITY of the BRAZILIAN STONE.* By
JAMES HUTTON, M. D. F. R. S. EDIN. and Member of
the Royal Academy of Agriculture at PARIS.

[Read Feb. 7. 1791.]

NO quality is more inconsistent with the character of a stone than flexibility. A flexible stone, therefore, presents an idea which naturally strikes us with surprise. For though among mineral bodies, we find flexible substances of the stony kind, such as mica, mountain leather, and amianthus, these minerals owe their flexibility, either to their thinness, or to the fibrous structure of their parts. Therefore, when a stone of any considerable thickness is said to have flexibility, we are led to think that here is something very extraordinary; and we wish to know upon what depends that quality, nowise proper to a stone.

SUCH, however, is the stone from Brazil, of which the Baron de DIETRICH read a description in the Royal Academy of Sciences, in January 1784. There is also at present, in the possession of Lord GARDENSTON, a specimen of stone, which corresponds with that description, inserted in the Journal de Physique for the year 1784*. The length of the stone which I have examined is twelve inches, the breadth about five, and the thickness half an inch. When this stone is supported by

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* Tom. xxiv. p. 275, 276.

the two ends in a horizontal position, the middle part bends by its own weight more than a quarter of an inch from the straight line. This species of flexibility may certainly be made a proper object of scientifical investigation. I am therefore induced to lay before this Society what has occurred to me upon the subject.

HARD bodies are either on the one hand friable, or on the other ductile. If they are friable, they are elastic ; if ductile, again, they preserve the change which has been forcibly induced upon their form, consequently are not in that sense elastic. Bodies, indeed, may be either friable or ductile in various degrees ; but, so far as friable, they are not ductile ; and, so far as ductile, they cannot be said to be elastic. But compound bodies may be flexible, without being either ductile or elastic ; such are jointed bodies. In that case, however, it is not to the nature of the substance that the body owes its flexibility, but more properly to its mechanical construction. Of this kind, certainly, is the body which we have now under consideration ; for it has a certain flexibility, to which neither the terms *ductile* nor *elastic*, will properly apply ; although, having no degree of ductility from the nature of its substance, it cannot, in like manner, be said to have no elasticity. The flexibility of this stone is so easy, compared with the rigidity of its substance, and its elasticity so small, compared with its flexibility, that there must be in this body some mechanical structure, by which this unnatural degree of flexibility is produced ; that is to say, a flexibility which is not inherent in the general substance of the body.

Now, the substance of this stone being chiefly quartz, the most rigid and inflexible of all materials, and the stone, at the same time, bending in such an easy manner, there is reason to conclude, that this arises from no principle of flexibility in the general substance of the stone, but from some species of articulation in the structure of it, or among its constituent parts ; which articulation.

articulation, while it preserves the component particles in one entire mass, suffers the parts to move a certain space in relation to each other.

BUT before dissecting this stone, in order to see upon what principle it holds its flexibility, it may be proper to form a distinct idea with regard to that inflexibility or rigidity which is to be found in other strata.

WE do not now enquire into the means employed by nature for uniting the incoherent particles of which our strata have been composed ; it is enough to know this fact, That strata are thus actually found, with their particles united in every possible degree, from the slightest contact to the most absolute confusion ; that is to say, from a mass of incoherent particles, they become bodies of the most perfect solidity, and may be found in every sensible stage of that progress. If they are slightly cemented, the stone is tender and extremely friable ; if much consolidated, the stone is strong, but inflexible, that is to say, with no more flexibility than the nature of the substance and the thinness of the body will admit of. It will here be evident, that with the same degree of cementation or consolidation, and with the same substance, the strength of the stone will depend upon the figure of the particles of which it is composed ; the spherical being that in which the particles are least disposed to be firmly united. But of whatever form the particles may be, or in whatever degree they may be cemented, so long as their parts, which are in contact, are united, and so long as those particles are rigid, no flexibility, at least of that kind which is the subject of the present examination, can take place.

THUS we may see, that in order to give any degree of the present flexibility, it is necessary the particles should not be all equally united, but be united in some parts, and disunited in others. By this means, a certain species of articulation may be formed ; an articulation which must be of a complicated nature,

ture, depending upon many circumstances ; and one which it may be very difficult to investigate among the small particles of this stone.

WE are now to endeavour to discover the peculiar structure or constitution of this Brazilian stone, by examining, as minutely as we can, the form and substance of its constituent parts, and that particular texture by which they are united.

UPON the upper and under surfaces of this thin stratum of stone, there is to be perceived a certain structure, which has a resemblance to a fibrous structure, but which is truly not fibrous. From more accurate inspection, it appears to arise from the reflection of longitudinal specular plates, which are all regularly arranged in one direction, consequently are parallel to each other. This gives some resemblance to a fibrous structure.

WHEN I examined these places with a microscope, I could perceive nothing like mica in them ; but they seemed to me to be the impression of mica which had so formed the transparent substance of the stone. In examining the transverse section of the stone, there appears nothing heterogeneous in its constitution, nothing micaceous, nor any distinct mark of stratification. The stone is porous or spongy, seemingly composed of nothing but pure transparent quartz, and shows neither a fibrous nor a laminated structure. It resembles nothing so much as a compressed stratum of snow. I now almost gave up every suspicion of mica in the composition of this stone ; and this will serve to show how deceitful may be certain appearances.

My next operation was to split this stone in the direction of its stratification, by pressing in the point of a knife. Here I found that this stratified body has truly a foliated structure, and a certain tenacity in the direction of its stratification, which admits of flexure before it breaks. The same striated appearance is here to be perceived in the internal horizontal section, as was observed upon the upper and under surfaces of this stra-

tum ; and this appearance likewise proceeds from the same kind of specular longitudinal plates, arranged in the same order.

I now bestowed some pains in endeavouring to discover, by the power of the lens, what was the nature of those reflecting specular laminae ; but I could not say assuredly, that there were two different substances in the construction of this stone. The irregular quartzy particles, and these specular bodies, seemed both to be of a perfectly transparent crystalline-like matter. I then had recourse to the blow-pipe, in order to resolve my doubts ; and this indeed soon made a distinction of the different substances contained in this stratum. Where the fragment of the stone had received the intense heat of the flame, the foliated specular structure totally disappeared ; and here the irregular quartzy particles remained seemingly without change. In the other part of the fragment, which had been heated to incandescence, the doubt with regard to the specular bodies was entirely removed, and the transparent mica had now assumed its natural appearance ; it had become opaque with regard to the transmission of light, at least comparatively, and it gave an argentine appearance by reflection, as may be perceived in the specimens which I have here laid before the Society.

I now could see, most evidently, the connection of the irregular structure of the quartzy particles, with those stratified parallel plates of mica ; and I also understood the reason why I could not before distinguish the proper connection of those two substances, which was no other than their perfect transparency. But being thus satisfied of the thin flexible plates of mica, we may now consider the particles of quartz, which have little cohesion, as being bound together by these thin plates of transparent mica ; and these connecting plates being flexible, this allows a certain motion of the rigid particles among themselves, without the fracture or general separation of the stone.

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WERE I to form a conjecture in relation to the natural history of this flexible Brazilian stone, I would suppose, that it had been originally, like many similar strata, attendant upon the Alpine limestones, consolidated with calcareous spar ; and that the consolidating substance had been afterwards dissolved out, as it always is in stones sufficiently exposed to the influences of the atmosphere. This supposition is also countenanced by the report, which I have received, with regard to the situation in which this solitary stone was found. It is said to have been in the soil or upon the surface of the earth. But without allowing ourselves to be led into any hypothetical speculations upon the subject, we may now reason from what appears more evident in the construction of this mineral.

NOTHING is more common in our north Alpine country, as well as in every other extensive country of the same kind, than strata of granular quartz and mica ; and in our low country, we have many micaceous sand-stones ; yet stones of that kind, with palpable flexibility, have not been observed. Therefore we have reason to believe, that it requires many conditions, seldom to be found together, in order to produce that flexibility which is so remarkable in this Brazilian stone. It is not enough to be composed of siliceous particles and plates of mica ; these must be duly proportioned and properly arranged. But when all the materials shall be justly proportioned and perfectly arranged, perhaps the most difficult part is still to come ; that is, the giving a proper union to the parts, so as to form a cohering stone, at the same time that the proper separation among those parts is so preserved as to allow them to move in relation to each other. Were all the particles united or cemented where they are in contact, it is plain that the flexibility of this stone would be lost ; and were there no union among the component particles, it would cease to be a stone ; a term which implies a certain degree of consistency or strength. But between those two extremes, there are not only many degrees,

but also a certain variety, arising from different modifications of those conditions. Thus, for example, the plates of mica may be united with the particles of quartz, while these inflexible particles are not united with each other. Here is a modification which may also take place in various degrees; for part of the quartzy particles may be cemented, while there is sufficient separation upon the whole, to admit of all the flexure which is here perceived.

I MAKE little doubt that something of this kind is the case with the present example; that is to say, that there is a sufficient connection among the parts to preserve the proper consistency of a stone, and a sufficient laxity in the composition to admit of many of its parts moving in relation to each other, at the same time that the whole is connected.

BUT if among the indefinite variety that may happen in the disposition of those materials, and in the still more various degrees in which the cementing or consolidating operation may proceed, there is but one in which the greatest degree of flexibility may be admitted of, we shall find reason to conclude, that while an example equal to the present may be extremely rare, yet that upon accurate observation, many stones of that kind may be found to possess small degrees of this species of flexibility, such as might pass unnoticed by common observation.

THE *stellsten* or *gestellstein* of the Swedes and Germans, which they employ for the building of furnaces, is a stone of this kind, being, according to CRONSTEDT, composed of quartz and mica. Let us now consider what is the quality in a stone which, besides being apyrous, is required in order to adapt it to that purpose, of being durable in a furnace. It is precisely the same quality that would procure a certain degree of flexibility to the stone. In proportion as a stone is solid and friable, it is improper for that purpose. But in a porous stone, there is also a certain texture that adapts it for resisting the alternate operations

operations of heat and cold, or the effects of frequent expansions and contractions, partially applied. Now, it is precisely the same structure which is required for those two purposes, that of procuring flexibility, and that of resisting fracture by the partial application of heat and cold; and the two things here compared, the stellsten and the Brazilian stone, are of the same construction, so far as composed of quartz and mica in the stratified structure of a schistus.

Now, though in comparing the common stellsten, or quartzy micaceous strata of the Alpine countries, with this Brazilian stone, the one may be said to be flexible and the other inflexible, this is but saying that the one of these is not sensibly flexible, as is the other. But how many degrees of flexibility may actually take place between that which may be sensible to common observation, and that at which flexibility must cease?

THEREFORE, in seeing the principle upon which the Brazilian stone possesses its flexibility, we may understand the quality of the stellstein which renders it so proper for the construction of furnaces; and, conversely, in understanding the structure of the stellsten, we may see the principle upon which the Brazilian fossil possesses flexibility in so eminent a degree.

BUT it would appear, that this is not the only species of stone which may have this remarkable degree of flexibility. M. le Baron de DIETRICH observes, that the marble tables, preserved in the Borghesé Palace at Rome, under the name of *Pietra elastica*, seem to have the same property. Now, M. FERBER found, that those tables were of a true antique white marble, the grains of which have but little cohesion; and the P. JAQUIER observed, among the grains of the marble, particles of talc. But among the Alpine strata, we find both those that are composed of granulated quartz and mica, and those that are composed of granulated calcareous spar and mica, so much resembling each other, that, without trying their hardness or their solubility in acids, it would be difficult to distinguish them.

them. While, therefore, the flexibility of those stratified bodies is considered as arising from a certain mechanical construction, in which flexible plates of talc or mica are united with the granulated body of the stone, it is of no consequence of what substance the rigid particles of the stone shall consist, since they do not alter their form during the flexure, but only move in relation to each other.

IV. *An Analysis of the WATERS of some HOT SPRINGS in ICELAND.* By JOSEPH BLACK, M. D. Professor of Medicine and Chemistry in the University of Edinburgh, First Physician to his Majesty for Scotland, Fellow of the Royal College of Physicians, and of the Royal Society of Edinburgh; Member of the Academy of Sciences and of the Society of Medicine of Paris, of the Imperial Academy of St Petersburg, &c. &c.

[Read July 4. 1791.]

SIR JOSEPH BANKS, to whose indefatigable ardour for the advancement of natural history, the philosophical world is so much indebted, made a voyage to Iceland in the year 1772, to enquire into the productions of that remote part of the world, and particularly into those of its famous volcano. When he returned, he brought from thence, among many other natural productions, some petrified vegetables, and incrustations, formed by the waters of the boiling springs; and he was so good as to present a part of them to his friends here, who were surprised to find them composed of siliceous earth. As this was the first example observed, of water containing this earth in such quantity as to form siliceous petrifications, it raised a strong desire to have an opportunity of examining the water, and of learning by what means this siliceous matter was dissolved in it; and this opportunity was at last given us by JOHN THOMAS STANLEY, Esq; who, excited by motives similar to those of Sir JOSEPH BANKS, equipped likewise a vessel, and made a voyage to Iceland, during the summer 1789. He brought

brought from thence, and from the Faro Islands, a number of fine specimens of volcanic and other fossil productions, and along with them, a quantity of the water of the two most remarkable boiling and exploding springs of Iceland, called by the natives *Geyzer* and *Rykum*; and having favoured me with a portion of these waters, and expressed his desire that I would examine them, I have accordingly made a number of experiments with them, an account of which I shall now submit to the Society. If the detail of it should appear tedious; if I shall be thought to have given much attention to very small matters; it must be considered, that the nature of the subject requires exactness. The quantities of the materials which are to be examined in such experiments, are but small, though it often happens, that these small quantities of matter, acting in nature for a great length of time, produce accumulations, and other effects, that appear very surprising and worthy of attention. I must also confess, that I took pleasure in promoting, as far as I could, the information concerning Iceland, which the philosophical zeal and spirit of the Gentlemen I mentioned, have procured for us.

BOTH these waters had a weak smell of the Hepatic Gas, or a small degree of the odour, which is well known in Harrogate, and other sulphureous waters. The quantity, however, of this sulphureous matter in them was so very small, that I was not able, by any experiments, to obtain it in a separate state, or bring it into view in any form whatever. I therefore could not make any attempt to estimate the quantity of it.

THOSE who are acquainted with sulphureous waters, know that an incredibly small quantity of their volatile sulphureous matter is sufficient to give a perceptible odour; and it is so liable to be decompounded and changed, while we attempt to separate it from water, that such an attempt never succeeds when the quantity of it is small. There was also reason to believe, that some part of it had already been lost or changed during the

voyage,

voyage, this matter being one of those volatile ingredients of mineral waters, which are the most liable to be evaporated or changed by the action of the air and other causes. I therefore think it sufficient to mention, that these waters contained a small quantity of this substance.

I BEGAN by making a few preliminary trials, to acquire some notion of the nature of these waters.

1. AN equal quantity of lime-water being added to the Iceland waters, there was a little diminution of transparency, but only in the smallest degree, and no sediment was formed.

2. MILD volatile alkali produced no effect whatever.

3. PAPER stained blue with the March violet, being dipped into the water and dried, had its colour changed a little towards a green.

4. CAMBRIC stained to a bluish purple, with infusion of litmus, assumed a more perfect blue colour, when dipped into the water and dried.

5. ACID of sugar did not produce a perceptible muddiness or precipitation.

6. NOR did the solution of corrosive sublimate.

7. THE solution of sal saturni (plumbum acetatum) made the water very muddy and white, but a small quantity of distilled vinegar redissolved nearly the whole of the precipitate, and made the water almost perfectly clear again.

8. THE solution of barytes in muriatic acid made the water become muddy, and deposite a sediment, which was not redissolved by adding purified nitrical acid.

9. THE solution of silver produced a strong muddiness and considerable precipitation, which was not redissolved by adding purified nitrical acid.

THE last trial shewed the presence of the muriatic acid, and the one preceding it, that of the vitriolic acid in the composition of these waters; but by the 3d, 4th and 7th, I also learned, that there was more than enough of alkaline matter to saturate

both of them. The 5th trial shewed that the alkaline matter was not calcareous earth, but alkaline salt; and the 6th, that this alkaline salt was not the volatile, but one of the fixed alkalis. The 1st trial shewed, that this unsaturated fixed alkali was not combined with air, or that if any was combined with it, the quantity was so small as to be scarcely perceptible.

NONE of these trials gave any indication of the earthy matter contained in these waters; and as my principal object was to investigate the nature of their petrifying power, I now began with the following experiment:

Evaporation of the Water.

I EVAPORATED 10,000 grains weight of each of these waters to dryness with a gentle heat, in separate glasses. The dry extract of the water of Rykum weighed gr. 8.25, and that of Geyzer, gr. 10.

THE evaporation was performed in cylindrical glass vessels, about 3 inches wide and $7\frac{1}{2}$ deep, which received heat from the steam of boiling water, not directly, but through the intervention of white-iron cases, which fitted the glasses, and in which they hung. I have often used this apparatus in examining and comparing different waters; and the advantages of it are, that the greater part of the fixed matter is collected on a small surface; that the glasses are so moderately heated, that they bear water to be added, during the evaporation, without danger of breaking; and, lastly, when the whole water is evaporated, the fixed matter, while it is thoroughly dried, by leaving it exposed some hours to the heat, never becomes so hot as to suffer the loss of any part of the acid of the saline compounds which it may contain, and when it is dry, the quantity of it is accurately determined, by weighing it in the glass, the weight of which can be

be ascertained, both before the water is put into it, and after the extract is taken out.

IN the end of these evaporation of the Iceland waters, they emitted an odour similar to that of alkaline leys, which contain an alkali not very pure or well calcined, and afterwards, when the evaporation was nearly completed, the residuum assumed the form of a transparent jelly, which had nearly the thickness of half a crown. This jelly afterwards became divided by fissures, into a great number of small portions, which, in drying, contracted their size, and greatly widened the fissures, forming at last a number of small fragments of white crust, unconnected with one another, and not adhering to the bottom of the glass. A small quantity only of this matter attached itself to the sides of the glass during the evaporation, and formed there circles of an exceeding thin incrustation, which adhered strongly, and required much patience to scrape it off with a knife.

THESE phenomena are exactly similar to those which appear in evaporating water which contains siliceous earth, dissolved in it artificially by means of an alkaline salt. The colour of the dry matter obtained from Rykum water, was almost a pure white, that of the water of Geyzer was a yellowish white.

WHILE these dry extracts were kept for some time in the glasses, placed in a cold room, in the winter season, they attracted humidity, and the extract of Geyzer attracted the most. Eight grains of the extract of Rykum attracted in one week four grains of humidity; the same quantity of the extract of Geyzer attracted in the same time ten grains of humidity. My attention, however, was turned for some time from these experiments; but resuming them again after some months, I found that these extracts remaining in the same glasses, and in the same room, had again become dry, and had lost the greater part of the weight which they had acquired at first by attracting humidity. This I imputed partly to the state of the atmosphere, and partly to their having attracted fixed air, by their

union with which they had lost their strong attraction for water.

THE constituent parts of these extracts were next to be investigated. I soon perceived that they contained a portion of alkaline salt not saturated with acid, which became evident when a small quantity of them was wetted and applied to paper stained with the juice of violets, or the colouring matter of the common purple radish ; the colour in either case was changed to a green, I further collected and scraped these extracts out of the glasses, and placing each in a small filtré, I dropped distilled water on them repeatedly, until the water came away from them insipid. The waters which had been thus filtrated through them were put into china cups, and the greater part evaporated with a gentle heat, the rest was allowed to evaporate spontaneously in a dry room. Thus, a number of small saline crystals were formed, which were partly regular crystals of common salt, and partly crystals of an oblong and flattened form, larger than those of the common salt. These larger crystals were distinguishable, not only by their form, but, by some of their properties. They became white, opaque and mealy in dry air, and being taken out, and tasted and tried in different ways, were found to contain some of the fossil alkali in a crystallized state.

THE undissolved matter which had remained on the filtrating paper, appeared by its properties to be totally or principally made up of siliceous earth. It was white and exceedingly spungy and light. A small portion of it was triturated, and made into a paste with water ; which paste being laid on a piece of charcoal and dried, was heated intensely with the blowpipe. No part of it was melted ; it was only contracted in its dimensions, and acquired a weak degree of cohesion. Another small portion was triturated dry, with an equal weight of aerated and exsiccated fossil alkali ; and being put into a small platina spoon, against the bottom of which the flame of the blowpipe was strongly

strongly directed, the mixture was soon melted into a transparent colourless glass, which afterwards, by being digested with a small quantity of distilled water, was completely dissolved, and formed a liquor which had all the qualities of the *liquor silicicum*.

I NEED not take notice here of the quantity of the earth and saline matter which were in some measure separated from one another in this experiment. I had reason to suspect, that neither of them were obtained in this way without some loss. The odour emitted by the water in the end of evaporation, gave reason to suspect the loss of some part of the salts ; and it was probable that a part of the earth would remain combined with the alkali, in a soluble state, in the dry extract, and would pass through the filtre, when I dissolved and washed away the saline matter.

I THEREFORE planned a set of experiments, by which the quantity of each ingredient in these waters might be more certainly known ; and began with the following

Experiments to investigate the quantity of the un-neutralized alkaline salt.

IN making the experiments to decide this question, I made use of an acid, which I had often employed before in experiments to learn the quantity of pure or caustic alkali, contained in aerated alkalis, and in various barillas, kelps, and other such heterogeneous masses. This acid was a quantity of the vitriolic, the power of which, in saturating pure alkalis, I had carefully examined, and I was accustomed to add it very gradually to filtrated solutions of the above substances, until they were exactly saturated ; and then, from the quantity of acid required to produce this effect, I learned the quantity of un-neutralized alkali which these substances contained. The specific gravity of this

vitriolic

vitriolic acid, compared with that of water, was as 1798 to 1000, in a temperature of heat equal to 60 of FAHRENHEIT. When I had used it on former occasions, I diluted some of it, with four times its weight of distilled water, and used this mixture in place of the pure acid, that I might the more readily portion it into small doses ; but on this occasion, I made a mixture of it, with about 100 times its weight of distilled water ; and essaying this mixture afterwards, with great attention, I found that 112 grains of it saturated one grain of the pure alkaline part of the alkali of tartar, and 171.55 grains were required for the saturation of one grain of the pure or caustic part of the fossil alkali.

WITH this largely diluted acid, the strength of which was thus ascertained, I began to investigate the quantity of alkali in the Iceland waters. I gave a pale purple or blue colour to a portion of the Rykum water, by adding a few drops of an infusion of litmus, the bluish purple of which became more blue when mixed with this alkaline water, and I began to add very gradually some of the largely diluted vitriolic acid, expecting to see the colour change to a reddish purple, when the alkali became completely saturated. This method, however, did not succeed so well as I had supposed ; for although I changed the colour to a reddish purple, or even to a pure red, by adding an exceeding small quantity of the diluted acid, the red thus produced was not permanent. Next day, I found it returned again to the blue, and requiring a new addition of acid ; and this happened so often, after repeated additions of acid, that this process appeared very tedious, and scarcely capable of being brought to a precise limit ; for in proportion as I continued the process the longer time, or had made the more numerous additions of acid, the time necessary for the return of the colour from red to blue was always the longer, and at last was no less than several weeks.

THESE

THESE phenomena appear to me to have proceeded from the very weak and slow action of the acid and alkali on one another, in consequence of the excessively diluted state in which they were mixed together, the alkali at the same time not being pure, but combined with the siliceous earth, a substance for which it has a considerable attraction. I therefore supposed that when I added the small doses of diluted acid, the acid particles remained for some time dispersed through the liquor, without joining the alkali, and the water contained, at the same time, a silicated alkali, if I may so call it, and an unsaturated acid; but the colour of litmus being much more disposed to be affected and changed by acids than alkalies, it became red, and retained this colour as long as any particles of the acid remained unsaturated. These, however, after some time, being all attracted and saturated by the alkali, the colour was again changed by the remaining unsaturated alkali.

IT may perhaps be suspected, that a small quantity of fixed air, detached from the alkali, might be the cause of this temporary red colour, and that the colour returned again to blue, when the fixed air evaporated from the water: And I know that a very small quantity of fixed air, contained in water, is sufficient to change the colour of litmus, and that a considerable time is required for its evaporation from the water, so that the litmus may recover its natural tint; but it is equally true, that the fixed air never requires so long a time for its evaporation as several weeks, and that it has not the power to redden litmus, when an alkali is present, except when the quantity of the alkali is exceedingly small, and that of the fixed air incomparably more than sufficient for saturating the alkali. In the present case, the last of these conditions never could take place, the quantity of acid added at once being far too small to detach enough of air, even although the alkali had been originally saturated with air, which it certainly was not; it appeared rather to be in a caustic state, or very nearly caustic. This reasoning suggested

suggested to me another mode of making the experiment, which succeeded perfectly in a moderate time.

THE foregoing experiments, and others which I made with small quantities of the water, enabled me to form some judgment of the proportion of acid necessary to saturate the alkali which this water contained. I therefore added to 10,000 grains of the Rykum water, 200 grains, accurately weighed, of the largely diluted vitriolic acid; which quantity I judged to be considerably more than sufficient for saturating the alkali of this water; and after the acid was poured in, the small and light glass in which it was weighed, was rinsed several times with distilled water, which was added to the Rykum water. I also gave it a pale tincture with some drops of the infusion of litmus, and then boiled the water gently in a thin bottomed glass, until it was reduced to one fourth of its first quantity. It still continued of a red colour, without the least tendency to a purplish hue, and shewed that the acid was more than enough to saturate the alkali.

IT was necessary, in the next place, to learn with certainty how much of the acid had been superfluous. With this intention, I added a largely diluted solution of alkali of tartar in distilled water. In this solution, the pure alkali, considered as distinct from the air which was joined to it, constituted one fortieth part of the weight of the fluid. I weighed 38.6 grains of this solution; which quantity I knew, by the previous experiments, was exactly or nearly sufficient for saturating the superfluous acid. I poured it at once into the hot water, and rinsing the small and light glass in which it was weighed two or three times with distilled water, I poured in this also. A little effervescence appeared in the hot water. I therefore set it again on the furnace to boil, that the fixed air might be expelled, and I added now and then a little distilled water, to prevent it from boiling down too much. In less than half an hour's boiling, the fixed air being all expelled, the colour changed

changed from red to purple, with a very small tendency towards the red. This shewed that the quantity of salt of tartar, which had been added, was exactly sufficient for saturating the superfluous acid. Had the saturation not been sufficiently exact, I could have added a little more of the alkali, or a little more of the acid, as I had done in the smaller essays which were preparatory to this; but the tint of colour which I had here produced, was that which I had found to be the most discernible and satisfactory sign of exact saturation, in former experiments; and it is proper to mention, that one grain more of the largely diluted vitriolic acid changed this purple very remarkably to a more decided red, and that with one grain less, the hue of the purple, by being inclined to blue, would have been equally distinguishable; of which I satisfied myself, by adding as much of the solution of salt of tartar as saturated one grain weight of the largely diluted acid.

THE quantity of the diluted acid added at first was 200 grains. From this was to be subtracted 108.32 grains, the quantity saturated by the 38.6 grains of the solution of salt of tartar; the remainder is gr. 91.68. From this quantity, however, we must make another deduction; for, as Professor BERGMAN justly observed, the infusion of litmus contains something which is of an alkaline nature, or is capable of saturating a certain quantity of acid. To learn how much was to be deducted on this account, I tinged a small quantity of distilled water, with the same number of drops of the infusion of litmus that I had used in tinging the Iceland water, and then making the distilled water boiling hot, I began to add some of the largely diluted vitriolic acid, and kept the water boiling all the time. The first additions of acid, as I expected, did not produce a change of colour, or, if any change was produced, it soon disappeared again, while the water was boiling; but as soon as I had added gr. 3.5, a permanent change was produced to a reddish purple: This quantity therefore must, in the next

place, be deducted from the gr. 91.68, and thus we have gr. 88.18, as the quantity of the diluted vitriolic acid which was employed solely in saturating the alkali of the water. But from the essays I had made of the power of this diluted acid in saturating alkalies, it is evident that this quantity of it was sufficient for saturating gr. 0.514 of the pure or caustic fossil alkali, or gr. 0.857 of that which is saturated with air and evaporated to dryness, or about gr. 2.38 of that which is saturated with air and in form of transparent crystals.

THE next step was to make a similar experiment to determine the proportion of alkali in the Geyzer water ; but here I found it necessary to change a little the mode of ascertaining the point of saturation.

THE water of Geyzer, by means of the sulphureous gas, which it contained in greater quantity than the other, and perhaps also by means of some of the other ingredients which it contained, and which gave it a light yellowish colour, produced such a change in the colour of litmus, that it could not be employed, as in the last experiment, by mixing it with the acidulated water and boiling them together ; the purple of the litmus was changed to an orange, which could not be made to return to blue or purple, although I added a quantity of alkali, which rendered the liquor very evidently alkaline, when it was examined by other trials. I therefore had recourse to the common method, which I had formerly practised in many other experiments of a similar nature, I mean the use of linen rags, or bits of cambric, which had been tinged with an infusion of litmus. A little bit of these, when touched with a liquor that is in the smallest degree acid or alkaline, has its colour changed from the purple to red or blue. This method is, next after the one employed in the last experiment, the most nice that I know ; provided that, in having recourse to it, we remember what was remarked in the former experiment, that the litmus colour is affected by acids in general much more easily than by alkalis ; and

and that, though a liquor contain a small quantity of alkali, if this be saturated and supersaturated with fixed air, the first effect of such liquor upon the stained paper will be to change it towards a red. This tint of colour, however, being produced by the superfluous aerial acid, is made to disappear, by drying the bit of cambric. The colour of it, while drying, will quickly change from the red to purple, and from that to blue, in consequence of the evaporation of the supersaturating air. Being apprised of this particular, I first made some preparatory experiments, with gr. 1000, and also with gr. 10,000 of the Geyzer water, and afterwards a more satisfactory one with gr. 10,000 of the same, in the following manner :

To gr. 10,000 of the Geyzer water, I added gr. 400, accurately weighed, of the largely diluted vitriolic acid, and began soon after to evaporate the water, by boiling it gently in a thin bottomed glass. The above quantity of acid I knew to be considerably more than what was sufficient for saturating the alkali.

THE water was boiled until it was reduced to a quantity little exceeding gr. 3000. I then added gr. 84.5 of the dilute solution of salt of tartar, and boiled the water again gently until it was reduced to gr. 2000. In weighing such small quantities of acid or alkaline liquors as were added to the water in these experiments, it is easy to adjust the weight with the greatest precision, by dipping the end of a slender glass rod, or of a pointed slip of paper, into the fluid. By these means, we can take up a quantity of it, as small as we please; and this method I likewise used, when I meant to add these fluids gradually, and by very small quantities at a time, to any mixture. The end of a slender glass rod was dipped into them, and afterwards transferred into the mixture.

WHEN I now examined the above boiled water, by means of the tinctured paper or linen rag, I found it reduced to the exact degree of saturation which I desired; that is to say, it scarcely

produced a change in the litmus colour, or if any change was produced, it was only a vergency towards the red, which was scarcely perceptible; and when the state of saturation was varied from this point, by an addition of 3 grains of the largely diluted vitriolic acid, or by an equivalent quantity of the alkaline solution, the tint of the colour was remarkably changed towards the red or towards the blue. Supposing therefore the above state of saturation exact, and I believe it to be the most exact that could be depended on, the quantity of largely diluted vitriolic acid, employed in saturating the fossil alkali of the water, was gr. 163.4; for the whole quantity added was gr. 400, and the salt of tartar of the gr. 84.5, of the dilute solution had required gr. 236.6 for its saturation. It follows, therefore, from the essays I had made, of the power of this diluted acid in saturating the pure or caustic fossil alkali, that the unsaturated quantity of this alkali, contained in the gr. 10,000 of the water, was gr. 0.952, which is equal to gr. 1.587 of the same alkali combined with air and evaporated to dryness, or gr. 4.409 of the same in a crystallized state.

THE reason for boiling these waters, with the quantities of acid which I had added to them, in these last experiments, is sufficiently obvious. The abundance of acid was meant to insure the complete saturation of the whole of the alkali, and separation of it from the siliceous earth; and the boiling promoted the same purpose, both by means of the heat which was applied, and also by bringing the acid and alkaline particles the nearer to one another, while the water evaporated.

A DOUBT may however possibly arise in the minds of some of my readers, whether this boiling of the water might not be attended with the dissipation of some part of the superfluous acid, which was not neutralized by the alkali of the water; and if any part of the acid was dissipated, the conclusions concerning the quantity of the alkali would be necessarily erroneous.

To

To remove this scruple, I took gr. 10,000 of distilled water, and added gr. 112 of the diluted acid. This mixture was then boiled down, in the same manner as the Iceland water ; that is to say, in a glass which had an oval or nearly globular body, about 5 inches deep, with a neck as long, and half an inch wide. This glass was placed in a shallow sand-heat, the bottom of which was a flat iron plate. The boiling was continued until three fourths of the water were evaporated, and then, removing it from the fire, I added gr. 40 of the dilute solution of salt of tartar. This neutralized it exactly, and shewed that no part of the acid had been dissipated in boiling ; and it continued to shew the signs of sufficiently exact saturation, after I had evaporated it further to the weight of one ounce, in which state, any superfluous alkali, by being less diluted, would have been more easily discernible.

Experiments to determine the nature and quantity of the earthy matter.

HAVING thus determined the quantity of unsaturated alkali in these Iceland waters, my attention was next turned to the earthy matter. A small part of this earthy matter came into view in the boiled and neutralized portions of these waters with which I had made the above described experiments. The neutralized liquors were a little muddy, and deposited slowly a small quantity of sediment, which collected itself closely to the bottom of the glass, and adhered to it slightly. This sediment, in the *Rykum* water, was deeply tinged with the colouring matter of the litmus ; in the *Geyzer* water, it had a brown tinge, and there was a little more of it than in the other. I collected these sediments, by first decanting the greater part of the liquor from them, and afterwards filtrating the rest in a small filtre, in which the sediment was washed, by passing distilled water.

water through it several times. Being then dried on the filtering paper, it contracted greatly, and was divided by fissures into a great number of small parts, as would have happened to fine clay, had the same quantity of it been dried on paper in a similar manner; and when it was separated from the paper, and further examined, it shewed the qualities of an argillaceous earth, combined with a small quantity of colouring matter. This appeared by the following experiments:

1. I PUT some of it, which I had procured in different experiments, into a platina spoon, and made it red hot. While heating, it first became black, then underwent a slight inflammation, and afterwards became white, without changing its external form, being only a little contracted in its size, and diminished in its weight.

2. To another small mass of it, laid on a plate of glass, I added a drop of aquafortis, which neither effervesced with it, nor dissolved it, but only changed the colour to a paler red.

3. ANOTHER small portion, which had been gently calcined, was well mixed with an equal weight of the aerated fossil alkali, and then exposed to a strong heat in the platina spoon. The alkali was quickly melted and became caustic; but I could not by its means bring the earth into fusion, or if any was dissolved by the melted alkali, it was only a very small portion, not perceptible by the appearances.

4. NOR did I succeed much better, when I tried to melt or dissolve it by means of borax, heated on charcoal with the blowpipe. A little mass of this earth continued undissolved in the melted borax, and without any appearance of effervescing with it, until I was tired of the experiment.

THIS earth therefore cannot be any other than the argillaceous. Had it been the siliceous, it would have been melted with the alkali into a transparent glass, which happened easily with different specimens of pure siliceous earth, subjected to the same trial; and had it been any of the alkaline earths, the borax would

would have dissolved it quickly with effervescence. The quantity of this earthy sediment, from either of these neutralized waters, was very small. From gr. 10,000 of *Rykum* water, I could only collect a quantity, which, after receiving an obscure red heat, weighed the twentieth part of a grain ; from the same quantity of the *Geyzer* water, I got about 38 or 39 hundredths of a grain.

IN one of my experiments with *Rykum* water, I got this argillaceous earth from it by another process. I had a dry extract, obtained by evaporating gr. 20,000 of this water, and which weighed gr. $16\frac{1}{2}$. Thirty grains of aquafortis were added to it. This aquafortis was made up of equal parts of the strongest nitrous acid and water. The extract was digested with it six or eight hours, and then distilled water being added, the mixture was filtrated in a small *filtre*, to separate the clear acid liquor from the undissolved matter. The filtrated acid liquor was then saturated, and a little more than saturated, with a pure aerated alkaline salt, and the saturated mixture was heated to a boiling heat. It became muddy, and deposited a small quantity of sediment like mucilage, which being collected by filtration, and dried, and heated to an obscure red heat, weighed just one tenth part of a grain, and had the qualities above enumerated, which shewed that it was an argillaceous earth. In another experiment, I digested an extract of *Geyzer* water with strong vitriolic acid, and thus got from it a similar earth ; but the quantity of it was very little greater than that which I had got by subsidence from the neutralized and boiled part of the same water, in the experiments above described.

THE greater part, however, of the earthy matter had not yet made its appearance ; I mean the siliceous earth. It still remained in a state of perfect dissolution in the neutralized and boiled mixtures above described, some part of which had actually passed through filtering paper ; and I learned, by other trials, that the whole of these neutralized mixtures might have been

been filtrated, without danger of separating any part of the siliceous earth from the water by that operation. This is a consequence of the singular nature of the siliceous earth, several properties of which, hitherto unnoticed, or not exactly described, I became acquainted with in the course of these experiments.

WE have no experience of the possibility of dissolving this earth in its concrete state by water alone; but if it be dissolved in water by means of an alkaline salt, although we afterwards completely saturate the alkali with an acid, the earth thus separated, provided there is enough of water, will not subside; it will remain dissolved; the mixture will appear perfectly transparent, and will pass through the filtre without the smallest difficulty. To gr. 1000 of the *Geyzer* water, I added more than enough of acid to saturate the alkali. I then boiled the mixture a little while, until a small part of it only was evaporated, and I set it aside in a quiet place. I know it contains a little more than half a grain of siliceous earth; but after standing twelve months, there is not the smallest appearance of separation, the mixture is still perfectly transparent and fluid in every part of it, though it be decidedly acid; and I know, that had it been boiled down to a proper degree, a separation of the siliceous earth would have happened in a short time. I learned this by another experiment with *Rykum* water. To gr. 1000 of this water, I added a quantity of acid more than sufficient for saturating the alkali. The water was then boiled till it weighed only 138 grains, and it was set up in my closet to remain undisturbed. In about eight days, the transparency of it was a little diminished, and afterwards there was a very slow subsidence of the matter which had produced this effect. It formed gradually, at the bottom, a stratum of some thickness, which was a little less transparent than the clear water above, and was thereby distinguishable from it. After a week or two more, I poured off the clear water entirely, without disturbing the sediment, which was in fact a tender jelly, adhering to the bottom

of

of the glass, and the upper surface of which was level and smooth. I knew the quantity of siliceous earth contained in it ; and comparing this with the weight of the water, when reduced by boiling to gr. 138, I found the proportion of the earth to that quantity of water to be as 2.68 to 1000 ; and having weighed the jelly by itself, the proportion of siliceous earth to the water in it, supposing that it contained the whole of the earth, was 10.88 to 1000. In another experiment, in which a similar mixture had been less boiled, and in which the siliceous earth bore to the water the proportion of 2.1 or 2.2 to 1000, I found a soft jelly formed at the end of forty days. And in another, in which the boiling and evaporation was continued until the jelly began to be formed in the upper part of the liquor while it was boiling, I found the proportion of the siliceous earth to the remaining water to be nearly as 3.75 to 1000.

AFTER this jelly is once formed, I never could bring it again into a state of dissolution by water alone, whatever quantity of this last was added.

IT appears therefore by these experiments, that when siliceous earth, united with an alkali, is dissolved in 1000 times, or in more than 500 times its weight of water, it will not separate or subside from that quantity of water, although we separate or disengage the alkali from it. The particles of it, placed at that distance, do not act on one another by their attraction of cohesion or concretion. It is necessary, in order to enable them to attract one another, that they be brought nearer, by diminishing the quantity of the water, until it be less than 500 times the weight of the earth. When this is done, they will enter into a state of cohesion, sooner or later, according as the water has been more or less diminished. But this state of cohesion into which they first enter, is also remarkable. The force of it is exceedingly weak, and it takes place while the particles of the earth are still at a considerable distance from one another. They therefore retain and entangle among them a large quantity

tity of water, amounting to about 100 times their own weight, and perhaps more than 200 times their bulk, with which they form a consistent jelly, almost perfectly transparent.

IT may be asked here, what prevents the particles of this earth from approaching one another more nearly, and entering into a state of stronger cohesion? We may, if we please, imagine that they retain round each of them, by chemical attraction, a quantity of water, which forms a little sphere or polyhædron, with the particle of earth in its centre. Thus, each particle is prevented from coming within a smaller distance of the other particles around it, than the diameter of that sphere; but let the water of these spherules be diminished in quantity by evaporation, in consequence of heat, or the attraction of the air, the particles of the earth will immediately enter into a state of closer connection and stronger cohesion, of which we have examples in the excessive contraction of the jelly, while it is dried up into crusts, and in those circles of thin incrustation which were formed on the sides of the glass-vessels, while the waters were evaporated to dryness in the first experiment, the particles of which were so strongly united to one another, and to the surface of the glass, that they cost me much trouble and time to scrape them off with a knife.

WHEN such a concretion is once formed of this earth, and afterwards receives frequent additions of the same matter, which, insinuating itself into the pores of the concretion, is fixed there, and increases its density and solidity, the mass may in time acquire a surprising degree of hardness. The petrifications of *Geyzer* are undoubtedly formed in this manner, and some of them are so dense and hard that they are scarcely distinguishable from agate or calcedony.

AFTER making these observations on the nature of the siliceous earth, the proper method for extracting it from the above boiled and neutralized portions of these waters, was sufficiently obvious. I separately evaporated them to dryness with a gentle heat

heat in two china cups, carefully washing every drop of them from the glasses into the cups with distilled water, and then taking out the dry extracts out of the cups, I put them separately into small filtrating papers, and passed distilled water through them repeatedly, until all the saline matter was washed away. The papers being then carefully dried, I found the earth in them exceedingly spungy, fine and tender. The quantity of it, obtained in this state from the gr. 10,000 of *Rykum* water, was gr. 3.8, which were reduced by the action of an obscure red heat to gr. 3.73 nearly. From the same quantity of the *Geyzer* water, I got gr. 6.8 of the dried earth, which, by a similar heat, were reduced to gr. 5.4, and these gr. 5.4 being digested with aquafortis, and again washed with distilled water, to extract any argillaceous earth that might remain in them, I obtained only gr. 0.1 of this earth, which added to the quantity obtained before, makes up gr. 0.48 of the argillaceous earth, from the gr. 10,000 of *Geyzer* water, the remaining gr. 5.3 being pure siliceous earth. Some of it was melted into a perfect glass in the platina spoon, with one half of its weight of aerated fossil alkali evaporated to dryness. The diminution of the weight of the dried earth, from gr. 6.8 to gr. 5.4, which happened when it was gently calcined, proceeded from some inflammable matter, which adhered to it at first, and gave it a yellowish colour. This colour changed first to black, and afterwards to a pure white, during the calcination. The inflammable colouring matter might have been received in part from the vessels in which the water was brought, some of which were tainted with the odour of spirituous liquors, or the water might have got a part of it from subterranean strata of clay, or other earths containing inflammable matter.

Experiments to learn the quantity of the neutral salts.

THE only ingredients of these waters, the quantity of which had not yet been examined, were the neutral salts. The preliminary experiments, and the appearances observed in the watery solutions of the extracts of these waters, gave me reason to be satisfied, that these neutral salts were partly common salt and partly Glauber's salt. To ascertain the quantities of them, I made the following experiments : I had some common salt, which had been refined by a second crystallization, and was in solid dry and large crystals. Of this I weighed ten grains exactly, which were dissolved in about half a pound of distilled water. I then added a solution of silver, which contained a little superfluous acid. The silver was precipitated in the form of luna cornea or argentum muriatum ; and I took care to add rather more than the quantity which the ten grains of common salt could precipitate. The luna cornea, after complete subsidence, and decantation of the saline water from it, was carefully collected on a small filtre, and well washed with distilled water, and thoroughly dried and weighed. I thus learned, that 100 parts of common salt are sufficient to give 235 of luna cornea. This enabled me to learn, by similar experiments, how much common salt is contained in the Iceland waters, and I found that the quantity contained in 10,000 grains of Rykum water was gr. 2.90, and in the same quantity of the Geyzer water, I found there was gr. 2.46 of common salt. Some of my readers may perhaps be inclined to suspect, that the Glauber's salt contained in the Iceland waters, might, by means of its vitriolic acid, contribute to the precipitation of a part of the silver ; but experiments have satisfied me, that a small quantity of vitriolic acid, or of any vitriolic salt, dissolved in a large quantity of water,

water, does not precipitate silver* ; and to prevent any part of the silver being precipitated by the alkali of the water, I added of purified aquafortis, more than enough to saturate the alkali, before I added the solution of silver.

ANOTHER set of experiments, on the same plan, but made with Glauber's salt and the solution of barytes, in place of common salt and solution of silver, enabled me to ascertain with equal exactness the quantity of Glauber's salt contained in these waters. I first learned that if pure Glauber's salt be perfectly exsiccated, by evaporating the water that is in its crystals, 10 parts of this exsiccated salt are sufficient to precipitate as much barytes, from its solution in muriatic acid, as will form 17 of barytes vitriolica. This fact being ascertained, I added some of the dissolved barytes, to separate portions of the Iceland waters, so long as any muddiness and precipitation was produced ; and I carefully collected, washed, dried and weighed the precipitates. I thus learned, that the water of Rykum contains in gr. 10,000 of it, as much Glauber's salt as would give gr. 1.28 of exsiccated Glauber's salt, and the water of Geyzer as much as would give gr. 1.46 †.

IN making these last experiments also, I added some purified nitrical acid to the Iceland waters, to prevent any precipitation of the barytes which might have been occasioned by the alkali of the water.

IN reviewing the experiments I have now described, if we neglect the small quantity of sulphureous gas, the contents of these waters will appear as follows :

* See the appendix to this paper.

† The method by which these small quantities of sediments and precipitates were collected and weighed, is explained in the appendix to this paper.

An ANALYSIS of

In gr. 10,000 of *Rykum* water there are,

Of caustic fossil alkali,	gr. 0.51
Argillaceous earth,	0.05
Siliceous earth,	3.73
Common salt,	2.90
Glauber's salt when exsiccated,	1.28
	<hr/>
Total,	8.47

In gr. 10,000 of *Geyzer* water,

Caustic fossil alkali,	gr. 0.95
Argillaceous earth,	0.48
Siliceous earth,	5.40
Common salt,	2.46
Glauber's salt exsiccated,	1.46
	<hr/>

Total, 10.75

THESE quantities of the ingredients, as determined by the above experiments, exceed the quantities of dry extract which I obtained by evaporation. Gr. 10,000 of the *Rykum* water gave by evaporation gr. 8.25 of dry extract, and the same quantity of *Geyzer* gave gr. 10 only. This difference, however, can easily be accounted for. It is well known that common salt, and other salts, suffer some loss by evaporation, when watery solutions of them are evaporated to dryness; and the odour which was perceived in the end of the evaporation of these waters, made me suspect that a little of the salt might have been lost. There was therefore no reason to expect that the result of the analytical experiments would tally exactly with the extract by evaporation. I was rather surprised and pleased to find that they

they came so near, and am perfectly satisfied that this analysis is as complete and exact as it was in my power to make it, with that quantity of water which I got for this purpose.

THE proportions of the above enumerated ingredients to the water in which they are contained, shew the quantities of them contained in an English gallon of 231 cubical inches, or 58,484 grains, which are as follows :

In an English gallon of *Rykum* water :

Caustic fossil alkali,	- - -	gr. 3.
Argillaceous earth,	- - -	0.29
Siliceous earth,	- - -	21.83
Common salt,	- - -	16.96
Glauber's salt exsiccated,	- - -	7.53

In an English gallon of *Geyzer* water :

Caustic fossil alkali,	- - -	gr. 5.56
Argillaceous earth,	- - -	2.80
Siliceous earth,	- - -	31.58
Common salt,	- - -	14.42
Glauber's salt exsiccated,	- - -	8.57

HAVING now stated the several ingredients of these hot springs, and their proportions, the principal questions which remain to be considered are, How is the siliceous earth dissolved in them, or combined with the water ? Has hot water alone a power to dissolve this earth, or was it dissolved by the medium of the alkali only ? And how came the salts which we find in these waters and the sulphureous gas to be combined with them ? As all attempts to answer these questions must be conjectural, different opinions will be formed concerning them ; and

and I may offer what I have imagined, without its being thought necessary to make an apology. Professor BERGMAN considered the siliceous earth in these waters as dissolved by the power of the hot water alone; and supposed, that water, aided by excessive heat, became a solvent of this species of earth. He formed this opinion, however, under disadvantageous circumstances, and from a partial view of the subject. He only knew that this earth is actually dissolved in these waters, and deposited by them, and that they spring out of the ground of a full boiling heat, with appearances of their having been hotter below. He did not know what other ingredients they contained along with the earth. As we now know they contain an alkali, which is a powerful medium for combining this earth with water, I do not think that the power of water alone to dissolve it can be admitted, until it is proved by direct experiments; and I am not of opinion that these will succeed. I am persuaded that both the siliceous and the argillaceous earth have been dissolved by the medium of the alkali, but at the same time that the violent and long continued heat contributed greatly, and was even necessary to this dissolution. The proportion of the caustic alkali to the earthy matter in one of these waters, is as $13\frac{1}{2}$ to 100; in the other it is 16 to 100. When we form artificial compounds of siliceous earth and alkali in these proportions, we find that cold water has no power to dissolve them, though boiling water, by length of time, would certainly act on them. Even cold water, or the humidity of the earth, is well known to penetrate the hardest glass that is exposed to it for years or for ages; and I have had the experience of the power of hot water to act on glass, when I have distilled water in the same glass retorts a great number of times, or evaporated water often in other glass-vessels. Their internal surface was evidently affected by the continued action of the hot water. Its first effect is to soften thin laminæ at the surface of the glass, and to make them separate from that surface, in consequence probably of

of their being swelled and extended by the water penetrating into them ; and by a longer action of the water, there is no doubt that they, or some part of them, are completely dissolved.

THOSE who may have objections against admitting, that a boiling heat, and great length of time, are sufficient aids to enable water to dissolve a compound of the siliceous earth with such a small proportion of alkali, may imagine this earth to have been at first combined with a larger proportion of alkali than that we now find combined with it, and that after it was dissolved in the water, a part of this alkali was neutralized by acid vapours, or acid substances, which the water found in its way towards the surface.

ON the whole, however, the supposition which appears to me the most probable is, that common salt and Glauber's salt, conveyed by sea-water, or contained in fossils formed from sea-plants, have been applied, under the influence of a violent heat, to some of the numerous earthy and stony strata which contain mixtures of siliceous and argillaceous earth ; that those salts have been in part decompounded, by the attraction of these earths for the alkali of the neutral salt, part of the acid has been dissipated, or changed into sulphur and sulphureous gas, by the action on it at the same time of inflammable matter, which we know to be present in many of the strata ; and that the compound of alkali and earthy matter has afterwards been long exposed, and continues exposed, to the action of the hot water. By such a supposition, we can imagine how the several ingredients of these hot springs became dissolved in them ; and this supposition appears the more probable, when we attend to the accurate observations of Mr STANLEY, on the nature of the country, and state of the soil, in which these two hot springs are found. The rocks and mountains, which are at a small distance, or in the immediate vicinity of each of them, are formed chiefly of different kinds of lava. The lower country and soil

at the foot of these, and in which the springs rise, is composed of fragments of these lavas ; but in digging into this soil or rubbish to a small depth only, these fragments are every where found resolving, or resolved, into a matter like clay. At a certain depth, the fragments of some species of lava remain entire and hard, while the rest are changed. At a greater depth, even these more durable kinds are found to have undergone the same change with the rest. As this change is produced by the constant action of the hot water, it probably depends on a gradual dissolution and extraction from these lavas of some of their ingredients, which are dissolvable in water ; and those which we have actually found in the water may have been some of these. But I offer all this as a conjecture only, which every person who does not like it is at liberty to reject.

I SHALL venture further to offer another conjecture, which some particulars I learned by Mr STANLEY's voyage to Iceland have suggested to my mind. It is concerning the origin of the pure sulphur, which is found at the surface of the earth, in the neighbourhood of many volcanos in different parts of the world. In Iceland, there are places in which sulphur is thus found in very great quantity, covering the surface of the ground, and that of the stones and rocks, in form of a thick crust, and constituting what are called sulphur banks. This was seen in Iceland in particular spots, in which there were very strong sulphureous hot springs, which emitted such a quantity of sulphureous or hepatic gas, that the air all around was infected with it to the highest degree, and the water itself was muddy and black, and constantly boiling. Now, as we know, that vital air has the power to decompose this gas, and to make it deposit the sulphur which it contains, I am of opinion, that the sulphur which appeared in such quantity in the vicinity of these springs, had been deposited and accumulated in this manner from the hepatic gas, which these strongly sulphureous springs have emitted during a great length of time.

APPENDIX.

IN order to shew, that such a small proportion of a vitriolic salt as is contained in the Iceland waters, has not the power to precipitate filver, I dissolved gr. 0.3 of exsiccated Glauber's salt, in gr. 2000 of distilled water, which thus contained a proportion of Glauber's salt rather greater than that contained in the Iceland waters. I then added five drops of purified aquafortis, and five drops of the solution of filver. The mixture remained transparent several days. I afterwards added gr. 0.7 more of the exsiccated Glauber's salt, without diminishing in the least the transparency of the mixture. After a few days more, I added gr. 9 of the exsiccated Glauber's salt. This produced a diminution of transparency, and the sediment subsided in a few days more. This sediment being carefully collected and dried, weighed gr. 0.3; but the clear liquor which had been filtrated from it, still retained the greater part of the filver. I therefore added to it some pure common salt, which precipitated all the rest of the filver, and this last precipitate, being also collected and dried, weighed just one grain.

WHEN I examined these two precipitates by means of the blowpipe, their qualities appeared to me so much the same, that I suspect the first was produced by a small quantity of common salt, contained imperceptibly in the Glauber's salt. If there were 12 or 13 parts of common salt in 1000 of the Glauber's salt, they were enough to produce the above quantity of the first precipitate; and as Glauber's salt is prepared from common salt, we can easily understand how a small quantity of the common salt may remain in it.

FOR the sake of those who may have occasion to undertake such chemical enquiries as that described in the above paper, I shall here mention the method by which I collected and weighed the small quantities of sediments or precipitates, which I obtained in some of these experiments. In most cases, the turbid liquor was left at rest in a cylindrical glass, until the sediment was so well collected at the bottom, that the greatest part of the liquor was quite clear, and then this clear part was carefully decanted; the rest, which could not be decanted without disturbing the sediment, was shaken, and poured gradually into a small filter, that the sediment might be collected upon the filter, and afterwards washed on it, by passing distilled water through it repeatedly. And this part of the process was much facilitated by the preparation of the filter, and some other little manœuvres. When, for example, I used for my filter a piece of paper about four inches in diameter, I began by folding it, and giving it the proper form; then I spread it open again, and warming it, I applied melted tallow or bees wax to the margin of it all round, until it was soaked therewith to the breadth of a full inch from the margin inwards, the middle part of it being carefully preserved clean. As soon as this was done, and while it was yet a little warm, it was folded again into the proper form of a filter, and retained in that state until it was cold. On a filter prepared in this manner, it is much more easy to collect a sediment together, and to wash it clean, than on an ordinary filter. In the first place, no part of the sediment adheres to or is deposited on that part of the paper which was soaked with tallow. The whole is collected on the clean part of the paper, and after it is collected there, I condense it into the centre as much as possible, by dropping the distilled water on the margin of that clean part all round, or a little above that margin, by which practice the scattered particles of the sediment are washed down into the bottom. Sometimes I apply what may be called a capillary jet of the distilled water, directed

rected with force to those parts of the scattered sediment which are more difficultly moved. Having thus condensed the sediment as much as possible, the filtre is left in a cool place to dry. When it is perfectly or nearly dry, I spread it flat on a table, and cut away all that part which was soaked with tallow, and also those parts of the clean paper to which the sediment does not adhere. The rest, with the sediment on it, is then well dried before a fire, and weighed, and the weight of it marked down ; and, lastly, in order to know how much of this weight is made up by the paper, I take care, before I prepare the filtre, to chuse another piece of the filtrating paper, equal in thickness to the one of which the filtre is made. This equality of thickness is judged of by holding the two pieces between the eye and the light ; or, for greater security, bits of the two pieces may be cut off, exactly similar and equal in form and size, and their weight compared, and allowance may afterwards be made for their difference of weight, if there be a difference. After weighing the bit of paper with the sediment on it, a proper bit of the reserved paper is laid flat on a smooth table or plate of glass, and the paper on which the sediment had been collected is laid over it, with the clean side undermost ; then a bit of card, somewhat less, but nearly of the same form, is pressed down on both the papers, and, with a pair of sharp pointed scissars, or a pen-knife, the undermost paper is cut exactly to the same shape and size as the uppermost, and is afterwards weighed. The weight of it being deducted from that of the former, we thus learn the weight of the sediment, with a greater degree of exactness, and with less trouble, than by any other method which I have been able to contrive. To complete this article, I beg leave further to add, that the most ready and convenient way to soak the margin of the filtrating paper with tallow or wax, is to hold it above a lighted candle, at a proper distance for warming it a little, and then melting the end of another candle, apply it immediately to the warmed

warmed paper, and repeat this, until the paper is prepared as above directed. The prominent part of the wick of the candle, which is thus melted, becomes a sort of pencil, which holds the melted tallow or wax, and facilitates the application of it, and the wick of a tallow candle, on account of its being thicker, is fitter for this purpose than the wick of a wax one.

THE last remark on these experiments I shall now make is, that, in the trials with the solution of barytes, the barytes vitriolica was formed in particles so very minute, that they did not all remain at first upon the filtre. Some of them passed through it, and made the filtrated liquor a little muddy; but by making this muddy liquor pass through the filtre a second time, it was made quite clear, the whole of the sediment being thus collected on the filtre.

V. *An ACCOUNT of the HOT SPRINGS near Rykum in Iceland :*
In a Letter to Dr BLACK from JOHN THOMAS STANLEY, Esq;
M. P. F. S. A. A. LOND. and F. R. S. EDIN.

[*Read Nov. 7. 1791.]*

DEAR SIR,

Alderley, August 15. 1791.

I HAVE been prevented hitherto, by various occupations, from acquitting myself of a promise you received from me, (I am ashamed to think how long a time since), that I would send you an account of the hot springs in Iceland, from whence the water was brought which you have lately analysed. I have trusted you would excuse a delay not altogether voluntary. It will be now my endeavour to gratify your curiosity as far as I am able; and to acquaint you with every particular, as well concerning the springs as the country near them, which I think you may find in the least interesting.

WE saw many springs in the course of our journey besides those I am going to describe; nor indeed are they confined to the part of the island we visited, but break out in every division of it. For a general account of the most remarkable, I refer you to a letter, written by Dr VAN TROIL, (the present Archbishop of Upsal), to Professor BERGMAN, published with some others concerning Iceland in the year 1777.

THE descriptions given by this author are so accurate, that it will not be in my power to give you much new information.

I must, in a great measure, repeat what he has said. It may be satisfactory, however, to you to have his relations corroborated; and some further details, with an account of the changes which, in a few instances, have taken place since he visited these particular springs in 1772, may contribute to explain their history, and the cause of their very singular appearances.

You received two kinds of water, one from a spring near a farm called Rykum, and the other from the fountain known by the name of the Geyzer, the most remarkable in the island. It rises near the farm of Haukadal, about forty miles from Rykum. They are both situated in the S. W. division of the island.

I SHALL begin with a description of the country and the springs near Rykum, and of the first view we had of them in our way from Rykavick to Mount Hecla. Rykum is situated in a valley, which, on account of its fertility, and the strong contrast it made with the dreary scenes we had passed since our last station, appeared to us with great advantage while we approached it. We had traversed a country, seven or eight miles in breadth, entirely overspread with lava, and other volcanic matter. It was surrounded with hills, not sufficiently high to be majestic, and too rugged and too barren to be pleasing. We were told by our guides, that, on a clear day, the summits of Hecla might be seen above those which were immediately before us; but heavy and lowering clouds, which threatened us incessantly with a storm, concealed every distant object from our sight.

We saw many districts in Iceland covered with lava; but I do not recollect one so uncouth and desolate as this. No vegetation was to be seen but that of a few stunted bushes of willow and birch, growing between the crevices and hollows of the lava, into which the wind had drifted sufficient soil for them to take root. We could discover no mount or crater from whence we

we could conjecture, with any degree of probability, the lava to have issued. It extended round us like a sea ; and it had burst perhaps from some part of the country it now covered, while the fire to which it owed its origin, had escaped with its showers of cinders and ashes, from some other orifice, and had formed one of the numberless cones we could discover amidst the neighbouring hills.

THE unpleasantness of our ride over this country was increased by the continual danger to which we were exposed of our horses falling. The road was no other than what the few travellers of the country, as they passed from their farms to Rykavick, had tracked over the lava where it was least rough ; but even this was interrupted by many breaks and crevices, formed by the cooling of the matter and the contraction of its parts.

To this uncomfortable scene succeeded the view of a rich valley, opening into an extensive green plain bounded by the sea. A river was seen winding between several fertile meadows ; and beyond these, the valley was terminated by a range of high and bold rocks. But our attention was chiefly attracted by the clouds of steam, which ascended in various parts of the valley from the hot springs, and by jets of water which, from some of them, were incessantly darted into the air.

We descended into the valley by a road winding over the lava, which, in one place, had flowed from the upper plain into the country below. On each side it had stopped abruptly, and had thus formed a perpendicular wall, at least sixty feet high.

We pitched our tents in a pleasant field, on the side of the river, opposite to the farm, and not far from it, and at the foot of the hills which bounded the valley. Several fragments of rocks, which had fallen from these, lay scattered round our station. These were entirely volcanic ; some of dark blue lava, not unlike basalte ; others of a yellow substance ; and again others of a gray lava, mixed with a great quantity of white

glass : But the most curious consisted of an heterogeneous mixture of various substances, cemented indiscriminately together by some operation, subsequent to their original formation, and so strongly, that the rock was broken with difficulty by our hammers. It consisted of pieces of black glass, (a lava in all probability much vitrified), and large pieces of a close, gray lava, the cavities and pores of which were filled with zeolites finely radiated. Some pieces of black lava, in parts compact, and in other parts so porous as to approach nearly to a pumice stone, were mixed with the rest of the mass. A mixture of these same substances, (the lavas, the glass and the zeolites), pounded in small grains, filled the spaces between the larger pieces, and connected the whole into a solid rock. The heat (if heat it was) which had cemented these materials, had not been strong enough to reduce any one to a state of fusion ; for the angles of the fragments were as sharply defined as if newly separated from their respective original beds.

THE rocks from whence these different masses have been detached, lay heaped together in so disjointed and irregular a manner, that some violent convulsion has evidently taken place among them since their first formation ; but similar appearances of disorder are to be seen in every range of hills in the country. Regular strata are no where to be met with. It appears as if all this part of the island, at different periods, had been thrown up from its foundations.

THE valley is in this place fertile, and nearly half a mile in breadth. It becomes more narrow towards the north ; and it is there rendered barren by heaps of crumbled lava, or other rubbish, brought down from the hills by the waters. These have the appearance of artificial mounds, and a great number of springs are continually boiling through them. Below the surface, a general decomposition seems taking place ; for almost wherever the ground is turned up, a strong heat is felt, and the loose earth and stones are changing gradually into a clay or bole
of

of various colours, and beautifully veined, resembling a variegated jasper. The heat may possibly proceed from a fermentation of the materials composing these mounds ; but more probably (I should conjecture) from the springs and steam forced up through them. The springs must have acquired their heat at some greater depth, from some constant, steady cause, (however difficult to explain), adequate to the length of time they have been known to exist, with the same unvaried force and temperature.

SPRINGS do not boil on or near these banks only. They rise in every part of the valley, and within the circumference of a mile and an half, more than an hundred might easily be counted. Most of them are very small, and may be just perceived simmering in the hole from whence the steam is issuing. This, trailing on the ground, deposits in some places a thin coat of sulphur. The proportion varies ; for near some of these small springs, scarce any is perceptible, whilst the channels by which the water escapes from others, are entirely lined with it for several yards. Neither the water, nor the steam from the larger springs, ever appear to deposit the smallest proportion of sulphur ; nor can the sulphureous vapour they contain be discovered, otherwise than by the taste of what has been boiled in them for a long time.

MANY springs boil in great caldrons or basons, of two, three or four feet diameter. The water in these is agitated with a violent ebullition, and vast clouds of steam fly off from its surface. Several little streams are formed by the water which escapes from the basons ; and as these retain their heat for a considerable way, no little caution is required to walk among them with safety.

THE thermometer constantly rose in these springs to the 212th degree ; and in one small opening, from whence a quantity of steam issued with great impetuosity, Dr WRIGHT observed the mercury rise, in two successive trials, to the 213th degree.

I HAVE already said, that the ground, through which many of the springs were boiling, was reduced to a clay of various colours. In some, the water is quite turbid; and, according to the colour of the clay through which it has passed, is red, yellow or gray.

THE springs, however, from whence the water overflows in any great quantity, are to appearance perfectly pure. The most remarkable of these was about fifty or sixty yards from our station, and was distinguished by the people of the neighbourhood, by the name of the little Geyzer. The water of it boiled with a loud and rumbling noise in a well of an irregular form, of about six feet in its greatest diameter; from thence it burst forth into the air, and subsided again, nearly every minute. The jets were dashed into spray as they rose, and were from twenty to thirty feet high. Volumes of steam or vapour ascended with them, and produced a most magnificent effect, particularly if the dark hills, which almost hung over the fountain, formed a back ground to the picture. The jets are forced in rising to take an oblique direction, by two or three large stones, which lay on the edge of the basin. Between these and the hill, the ground (to a distance of eight or nine feet) is remarkably hot, and entirely bare of vegetation. If the earth is stirred, a steam instantly rises, and in some places it was covered with a thin coat of sulphur, or rather, I should say, some loose stones only were covered with flakes of it. In one place, there was a slight efflorescence on the surface of the soil, which, by the taste, seemed to be alum.

THE spray fell towards the valley, and in that direction covered the ground with a thick incrustation of matter which it deposited. Close to this, and in one spot very near the well itself, the grass grows with great luxuriance.

WHERE the soil was heated, it was gradually (as on the mounds) changing into a clay. But it was here more beautiful than in any other place. The colours were more varied and bright,

bright, and the veins were marked with more delicacy. The transition likewise from one substance into the other, was more evident and satisfactory.

To the depth of a few inches, the ground consisted of loose lavas, broken and pounded together, of blue, red and yellow colours. The blue lava was hardest; and several pieces of it remained firm and unaltered, while the rest were reduced to a dust. The colours became brighter as the decomposition of the substances advanced, and they were changed at the depth of nine or ten inches into a clay; excepting, however, the pieces of dark blue lava, which still retained sufficient hardness to resist the pressure of the finger. Round these, (which appeared insulated in the midst of the red and yellow clay), several veins or circles were formed of various shades and colours. A few inches deeper, these also became part of the clay, but still appearing distinct, by their circles, from the surrounding mass. The whole of this variegated substance rested on a thick bed of dark blue clay, which had evidently been formed in the same manner from some large fragment of blue lava, or stratum of it, broken into pieces.

THE resemblance of these clays to jasper is so striking to the eye, that I cannot forbear believing their origin to be similar, at least, that some circumstances in the formation of each are the same. You will say, with reason, that the difference, notwithstanding the apparent similitude, is in reality very wide; that these clays, before they can be converted into jaspers, require to be consolidated, and impregnated with a considerable proportion of siliceous earth. It is something, however, to have detected nature in the act of forming, in any substance, the veins and figures common to marbles and jaspers. What still remains of the process, after thus much of it has been traced, may not long continue unknown; and in Iceland, probably sooner than elsewhere, will be discovered beds of clay, like this, hardening into stone, either by the effect of subterraneous heat

or

or pressure promoting an adhesion of the particles, or by some insinuation of matter (perhaps siliceous) into the pores of the mafs.

THERE is another fountain in the valley not much inferior in beauty to that which I have described. It breaks out from under one of the mounds close to the river. Its eruptions are, I think, in some respects, more beautiful than those of the former. They rise nearly to the same height, and the quantity of water thrown up at one time is greater, and not so much scattered into spray. The jets continue seldom longer than a minute, and the intervals between them are from five to six minutes. They are forced to bend forwards from the well, by the shelving of the bank, or probably their height would be very considerable ; for they appear to be thrown up with great force. We never dared approach near enough to look deep into the well ; but we could perceive the water boiling near its surface, from time to time, with much violence. The ground in front of it, was covered with a white incrustation, of a more beautiful appearance than the deposition near any other spring in this place. By a trial of it with acids, it seemed almost entirely calcareous.

I HAVE now described to you the two most remarkable fountains in the valley of Rykum, the only two which throw up water to a considerable height with any regularity. There are some from whence, in the course of every hour or half hour, beautiful jets burst out unexpectedly ; but their eruptions continue only a few seconds, and between them the water boils in the same manner as in the other basons.

TOWARDS the upper end of the valley, there was a very curious hole, which attracted much of our attention. It seemed to have served at some former period as the well of a fountain. It was of an irregular form, and from four to five feet in diameter. It was divided into different hollows or cavities at the depth of a few feet, into which we could not see a great way, on

on account of their direction. A quantity of steam issued from these recesses, which prevented us from examining them very closely. We were stunned while standing near this cavern, and in some measure alarmed, by an amazing loud and continued noise which came from the bottom. It was as loud as the blast of air forced into the furnace from the four great cylinders at the Carron iron-works.

WE could discover no water in any of the cavities ; but we found near the place many beautiful petrifications of leaves and mosses. They were formed with extreme delicacy, but were brittle, and would not bear much handling ; their substance seemed chiefly argillaceous.

WE perceived smoke issuing from the ground in many places in the higher parts of the valley, much further than we extended our walks. I am sorry to say we left many things in this wonderful country unexamined ; but we were checked in our journey by many circumstances, which allowed us neither the leisure nor the opportunity for exploring every part of it as we could have wished. The substances deposited near the different springs seemed to me, in general, a mixture of calcareous and argillaceous earths ; but near one spring, not far from our tents, there seemed to be a slight deposition of siliceous matter. To the eye it resembled calcedony ; but with its transparency, it had not the same hardness, and, if pressed, would break to pieces. The water you have analysed came from this spring, and we were obliged to take some care in filling the bottles ; for though gradually heated, they would break when the water was poured into them, if it had not been previously exposed to the air for some minutes in an open vessel.

THE water of this spring boiled, as in most of the others, in a cauldron four or five feet broad. I do not recollect to have seen any of it ever thrown up above a foot, and some meat we dressed in it tasted very strongly of sulphur.

Mr

Mr BAINE, by a measurement of the depth, the breadth and the velocity of the stream flowing from the little Geyzer, found the quantity of water thrown up every minute by it to be 590.64 wine gallons, or 78.96 cubic feet. Mr WRIGHT and myself followed the stream, to observe how far any matter continued to be deposited by the water. We found some little still deposited where it joined the river, a quarter of a mile at least from its source. At that place, it retained the heat of 83 degrees by FAHRENHEIT's thermometer.

THE vegetation on the banks of the stream, and in the pleasant meadows through which it flows, is exceedingly luxuriant. The farmer and his people were at this time employed in cutting the hay in them, which, though not high, was thick, and remarkably sweet. The plants which Mr WRIGHT found in the greatest perfection, were the sedum acre *, the veronica bec-bunga †, the polygonum viviparum ‡, and the comarum palustre ||.

A LITTLE above, where the current from the little Geyzer falls into the river, part of the lava, which has descended from the upper into the lower plain, has assumed close to its banks, for the space of some yards, a regular columnar shape. The pillars are short, and have five or six sides. I cannot be very exact in my account of them, as they were on the opposite side of the river. I should suppose they were nearly a foot and an half in diameter. Some were horizontal, and others vertical. We observed the same appearance in many of the tracts of lava we traversed on our journey, and, in one or two instances, in those which had flowed from the sides of Mount Hecla, though the pillars there were less perfectly defined.

So many streams of hot water fall into the river, that it receives from thence a very perceptible degree of heat. The thermometer,

* Pepper stone crop.

† Snake weed.

‡ Brook lime.

|| Purple marsh arquefoil.

thermometer, immersed in it above where it is joined by the waters of the Little Geyzer, rose to 67 degrees, while in the open air it stood at 60. The breadth of the river in the same place is forty feet; its mean depth two feet and an half, and its course is rather rapid. Several kinds of fish are found in it; in particular, numbers of very fine salmon.

THE village of Rykum or Ryka, called either indiscriminately, from *Ryk*, an Icelandic word, signifying smoke, is situated in the middle of the valley, and, by an observation made by Mr BAINE, is in latitude $64^{\circ} 4' 38''$ N. about twenty miles from Rykiavick, and eight or ten from Oreback, a small harbour on the southern coast of the island. The village consists of the farmer's house, and the houses of his servants or dependants, and a small church. All the adjacent lands belong to him, and he keeps a considerable number of sheep and cattle, and some few horses. These constitute his riches; and he purchases at Rykiavick, with skins, wool and butter, whatever he requires, of which the chief article is fish, for his winter's provision.

I HAVE now related to you every circumstance that has occurred to me worth mentioning concerning this interesting valley. I have regretted much, however, my inability to give you a more accurate account of some parts of it; in particular, of the many springs which break out near the hills to the north, and of the rocks above the field where we placed our tents, which deserved more attention than I gave to them. But we remained in this valley a short time only, and the weather, during our continuance there, was very unfavourable. I shall here close this letter, and reserve for another (which you may very soon expect) the account I have yet to send you of the Great Geyzer and the springs near Haukadal. I am, Dear Sir, with great esteem, your most obedient servant,

JOHN THO. STANLEY.

VI. *An ACCOUNT of the HOT SPRINGS near Haukadal in Iceland: In a second Letter to Dr BLACK from JOHN THOMAS STANLEY, Esq; M. P. F. S. A. A. LOND. and F. R. S. EDIN.*

[*Read April 30. 1792.*]

DEAR SIR,

Grofvenor Place, March 30. 1792.

PART of my promise has been accomplished in a former letter, in which I gave you the fullest account I could of the springs of boiling water that rise in the valley of Rykum. It now remains for me to send you a description of those we visited in the neighbourhood of Haukadal.

THESE last are the most remarkable in the island, and the eruptions of water from some of them so astonishing, that I doubt whether any adequate idea of their effect can be given by description. Abler pens than mine might fail probably in attempting to do justice to such wonderful phenomena. The objects, however, are so highly interesting in themselves, that even the simplest narrative that can be given of them will be read with more than ordinary attention.

THEY are situated about six and thirty miles from Mount Heckla, and about twelve miles, in a north-east direction, from the village of Skalholt*. The road from thence to the springs

is.

* Skalholt consists of the Cathedral, a large building of wood, and of a very few houses belonging to the Bishop and his dependants. The Bishops of the southern division.

is over a flat country, which, although marshy in several places, is not unpleasant to the eye, and abounds in excellent pasture.

THE steam ascending from the principal springs during their eruptions, may be seen from a considerable distance. When the air is still, it rises perpendicularly like a column to a great height; then spreads itself into clouds, which roll in successive masses over each other, until they are lost in the atmosphere. We perceived one of these columns, when distant sixteen miles at least, in a direct line from Haukadal.

THE springs mostly rise in a plain, between a river that winds through it, and the base of a range of low hills. Many however break out from the sides of the hills, and some very near their summits. They are all contained, to the number of one hundred or more, within a circle of two miles.

THE most remarkable spring rises nearly in the midst of the other springs, close to the hills. It is called Geyzer*; the name probably in the old Scandinavian language for a fountain, from the verb *geysa*, signifying *to gush*, or *to rush forth*. The next most remarkable spring rises at a distance of one hundred and forty yards from it, on the same line, at the foot of the hills. We called it the New Geyzer, on account of its having but lately played so violently as at present.

THERE are others of consequence in the place, but none that approach to these in magnificence, or that, when compared with them, deserve much description. The generality of the springs are in every respect similar to those near Rykum; boil-

S₂ **is** **to** **be** **ing**

sion of Iceland have always resided there; but in future their residence will be at Rykiavick, a town now building on the south-west coast of the island. The present Bishop, however, the worthy and learned Mr FINSEN, has obtained the permission of continuing his residence at Skalholt during the remainder of his life.

* Three or four only of the principal springs in Iceland are distinguished by the name of Geyzer, and of all the springs near Haukadal the greatest is alone called Geyzer or Great Geyzer.

ing in caldrons of three or four feet diameter, and some of them throwing their water from time to time by sudden jets into the air. Many springs in this place, as in the other, boil through strata of coloured clay, by which they are rendered turbid. Here, however, the red clays were brighter, and in a greater proportion to the clays of other colours. Here also, as in the valley of Rykum, are many small springs, which throw out sulphureous vapour, and near which the ground, and the channel of the water, are covered and lined with a thin coat of sulphur.

THE farm of Haukadal, and the church of the parish, stand near to each other about three quarters of a mile beyond the great spring. The house is one of the best built in Iceland. It occupies a large space of ground, and consists of several divisions, to each of which there is an entrance from without. Some of these are used as barns and stables for the cattle, and others as work-shops *. The dwelling part of this house was small, but comfortable. There was a parlour with glass windows, a kitchen, and separate bed-chambers for the family. The building was partly of stone, partly of wood, and covered with sods, under which the bark of birch trees on boards are generally placed, as a greater security against rain.

We were obliged to the mistress of this farm, who was a rich widow, for a very hospitable reception, although at first she seemed to consider us rather as unwelcome visitors, and left us, though we had requested admittance into her house, as we were drenched with rain, and our tents and baggage not yet arrived, to take up our lodging in the church. We had not been long there, however, before she invited us to her house, and

* As the division of labour is yet very imperfect in Iceland, the farmer is under the necessity, either of exercising himself the several trades required in the formation of the instruments of agriculture, or of maintaining such servants as are capable to supply them.

and by her kindness made ample atemds for her former inattention. She put us in possession of her best room, and set before us plenty of good cream, some wheat cakes, sugar, and a kind of tea made of the leaves of the *dryas octopetala* *.

I MENTION these circumstances of our reception at Haukadal, as characteristic of the manners of the Icelanders. Several times during my stay in the country, I experienced this succession of civility to coldness. The Icelanders are naturally good, but not easily roused to feeling. When once their constitutional indifference was overcome, we usually found them desirous of pleasing, and zealous to do us service.

As the house was not sufficiently large to contain the whole of our party, we were under the necessity of returning again to the church as soon as our baggage arrived. Here we passed the first and second nights of our stay, in the neighbourhood of the springs. On the third day, we left Haukadal, to fix ourselves in some station nearer to them, from which we could watch their eruptions with more convenience.

THE view from near the church was very beautiful. It extended toward the south along the plain into an open country. On the other sides, it was bounded by hills, which had not the barren and rugged appearance that deform almost every scene in this division of the island. It was, however, still finer from some of the eminences near the springs. The plain and the surrounding mountains, seen from a height, appeared to more advantage; and the eruptions from the great wells breaking from time to time, the general stillness that prevailed, were much more distinct. The course of the river, winding under the eye, could be traced with greater accuracy. It flows through

the

* Called in English the Mountain Avens. We found this plant growing very luxuriantly, and in great abundance, in every part of Iceland that we visited.

the plain into an open country, where, being increased by the waters of numerous streams and rivulets, it bends to the westward, and near Skalholt falls into a considerable river, the Huit-aa.

THE pleasant and fertile pastures near its banks were enlivened by numerous herds of cattle and sheep, the united riches of three or four farmers in the neighbourhood of Haukadal. The mowers also at work in the different fields surrounding each house, gave, at this season, additional beauty to the prospect. High hills to the westward were separated from the eminencies immediately above the springs by a narrow valley. They were partly clothed with bushes of birch, which, although in no place above five feet high, were gratifying to the sight, which so seldom in Iceland can rest on any appearance even of underwood. Above these, some vegetation still continued to cover the sides of the hills, and Mr WRIGHT found a variety of plants * near their summits, which were certainly, in some places, not less than sixteen hundred feet above the plain.

To the eastward, the plain, several miles in breadth, was bounded by a long range of blue mountains, extending considerably to the south. Beyond these, the triple summit of Heckla may be seen from the western hills; but I could not distinguish it from the plain, or even from the heights whence the view of the surrounding country was taken which I am now describing.

To the north behind Haukadal, there were many high mountains, but at a great distance, and of which the most distant were covered with snow. They formed part of a dreary assemblage

* Amongst others, he found the *Salix herbacea* (teft willow), the *Cerastrum tomentosum* (woolly mouse ear chickweed), the *Rumex digynus* (round leaved mountain sorrel), and the *Koenigia*, (a plant peculiar to Iceland), growing in great abundance, though generally in low and marshy grounds.

assemblage of *Fokuls* or ice-mountains, which occupy a considerable extent of the interior country. Their forms were mostly conical; and from their general resemblance to other mountains in the island, from which streams of lava have been emitted, I think it probable they were once volcanos. They are not so connected as to form a continued range or chain of hills. Each stands insulated; and therefore the snows which have for ages rested on their sides, are no where accumulated in valleys and converted into lakes of ice and glaciers, as amidst the Alps of Switzerland and Savoy.

A view so different from the general features of the country, impressed us with the most agreeable sensations. Hitherto we could but compare one scene of dreariness with another; and although the view before us was destitute of trees, yet the verdure, and pleasant distribution of hills and plain, in some measure compensated for this deficiency.

I now return to the account of the springs, which I have already observed break out in different places from the sides of a hill, and the space inclosed between its base and the windings of a river. The soil through which they rise is a mixture of crumbled materials, washed by degrees from the higher parts of the hill. In some places, these have been reduced into a clay or earth; in others, they still remain loose and broken fragments of the rocks from whence they have fallen, or a dust produced by their friction against each other. Wherever the ground is penetrated by the steam of the springs, these fragments are soon decomposed, or changed into coloured clays. In other places, the surface of the ground is covered with incrustations deposited by the springs, or with a luxuriant vegetation of grafts or dwarf bushes of willow and birch, and the *empetrum nigrum**, the berries of which were at this time ripe and in great abundance.

ABOVE.

* The crow berry. This is almost the only fruit we met with in Iceland. Mr WRIGHT found a few strawberries. Neither gooseberries nor currants will come to perfection by any management whatever.

ABOVE the great spring, the hill terminates in a double pointed rock, which MR BAINE found by measurement to be 310 feet higher than the course of the river. The rock is split very strangely into lamina, and at first sight has much the appearance of a schistus or bed of thick slate. It consists, however, of a gray coloured stone of a very close grain, the separate pieces of which, although divided as they lay, do not break in the hand in any particular direction. I should suppose the substance of this rock to be chiefly argillaceous, and that, like every other stone in the island, it has suffered some change by the action of fire. I do not mean to call it lava, as it bears no mark of having been once in a melted state, whatever baking or induction it may have sustained in the neighbourhood of subterraneous heat. It contains no heterogeneous matter, or cavities, in which agates, or zeolites, or vitrified substances of any kind, could have been formed.

ALL these rocks that have been either altered or created by fire, seem much more liable to decay and decomposition than any others I have ever seen. Mounds, similar to those in the valley of Rykum, have been formed by the ruins of the hill half way up its ascent between the Geyzer and the pointed rock. Springs boil in many places through these mounds, and near to one of them, I observed that the coloured clay felt much more soapy than any I had tried before. This quality probably was owing to a greater proportion of the earth of magnesia in its composition, as in other respects it agreed perfectly with the rest.

My attention, during the four days I remained in this place, was so much engaged by the beauties and remarkable circumstances of the two principal springs, that I cannot (were I so inclined) give you a minute account of those which, next to them, were deserving of notice. The springs in general resemble those at Rykum; but there are five or six which have their peculiarities, and throw up their waters with violence to

a considerable height. Their basons are of irregular forms, four, five or six feet in diameter, and from some of them the water rushes out in all directions, from others obliquely. The eruptions are never of long duration, and the intervals are from 15 to 30 minutes. The periods of both were exceedingly variable. One of the most remarkable of these springs threw out a great quantity of water, and from its continual noise we named it the Roaring Geyzer. The eruptions of this fountain were incessant. The water darted out with fury every four or five minutes, and covered a great space of ground with the matter it deposited. The jets were from thirty to forty feet in height. They were shivered into the finest particles of spray, and surrounded by great clouds of steam. The situation of this spring was eighty yards distant from the Geyzer, on the rise of the hill.

I SHALL now, Sir, attempt some description of this celebrated fountain, distinguished by the appellation of Geyzer alone, from the pre-eminence it holds over all the natural phenomena of this kind in Iceland.

By a gradual deposition of the substances dissolved in its water for a long succession of years, perhaps for ages, a mound of considerable height has been formed, from the centre of which the Geyzer issues. It rises through a perpendicular and cylindrical pipe, or shaft, seventy feet in depth, and eight feet and a half in diameter, which opens into a basin or funnel, measuring fifty-nine feet from one edge of it to the other. The basin is circular, and the sides of it, as well as those of the pipe, are polished quite smooth by the continual friction of the water, and they are both formed with such mathematical truth, as to appear constructed by art. The declivity of the mound begins immediately from the borders of the basin. The incrustations are in some places worn smooth by the overflowing of the water; in most, however, they rise in numberless little tufts, which bear a resemblance to the heads of cauliflower.

liflowers, except that they are rather more prominent, and are covered, by the falling of the finer particles of spray, with a crystalline efflorescence so delicate as scarcely to bear the slightest touch. Unmolested, the efflorescence gradually hardens, and, although it loses its first delicacy, it still remains exceedingly beautiful.

THESE incrustations are of a light brown colour, and extend a great way, in various directions, from the borders of the basin. To the northward, they reach to a distance of 82 feet; to the east, of 86; to the south, of 118; and of 124 to the west. They are very hard, and do not appear, in any part, decaying or mouldering into foil*.

WHEN our guides first led us to the Geyzer, the basin was filled to within a few feet of its edge. The water was transparent as crystal; a slight steam only arose from it, and the surface was ruffled but by a few bubbles, which now and then came from the bottom of the pipe. We waited with anxiety for several minutes, expecting at every instant some interruption to this tranquillity. On a sudden, another spring, immediately in front of the place on which we were standing, darted its waters above an hundred feet into the air with the velocity of an arrow, and the jets succeeding this first eruption were still higher. This was the spring already mentioned under the name of the New Geyzer.

WHILE gazing in silence and wonder at this unexpected and beautiful display, we were alarmed by a sudden shock of the ground

* The substance of these incrustations has been analysed by Professor BERGMAN, and he gives a long and particular account of it, in a letter to the Archbishop of Upsal, published with the Archbiishop's Letters on Iceland. He says, "The strongest acids, the fluor acid not excepted, are not sufficient with a boiling heat to dissolve this substance. It dissolves very little (if at all) by the blow-pipe with the fusible salt of urine, a little more with borax, and makes a strong effervescence with sal soda. These effects are peculiar only to a siliceous earth or flint. There cannot remain therefore a doubt concerning the nature of this crustated stone."

ground under our feet, accompanied with a hollow noise, not unlike the distant firing of cannon. Another shock soon followed, and we observed the water in the basin to be much agitated. The Icelanders hastily laid hold of us, and forced us to retreat some yards. The water in the mean time boiled violently, and heaved as if some expansive power were labouring beneath its weight, and some of it was thrown up a few feet above the basin. Again there were two or three shocks of the ground, and a repetition of the same noise. In an instant, the surrounding atmosphere was filled with volumes of steam rolling over each other as they ascended, in a manner inexpressibly beautiful, and through which, columns of water, shivering into foam, darted in rapid succession to heights which, at the time, we were little qualified to estimate. Indeed, the novelty and splendour of such a scene had affected our imaginations so forcibly, that we believed the extreme height of the jet to be much greater than it was afterwards determined to be. In a subsequent eruption, Mr BAINE ascertained, by means of a quadrant, the greatest elevation to which the jets of water were thrown, to be 96 feet.

MUCH of the water began to descend again at different heights, and was again projected by other columns, which met it as they arose. At last, having filled the basin, it rolled in great waves over its edge, and forming numberless rills, made its way down the sides of the mound. Much was lost in vapour also, and still more fell to the ground in heavy showers of spray. The intervals at which the several jets succeeded each other, were too short for the eye to distinguish them. As they rose out of the basin, they reflected, by their density, the purest and most brilliant blue. In certain shades, the colour was green like that of the sea; but in their further ascent, all distinction of colour was lost, and the jets, broken into a thousand parts, appeared white as snow. Several of them were forced upwards perpendicularly; but many, receiving

a slight inclination as they burst from the basin, were projected in beautiful curves, and the spray which fell from them, caught by a succeeding jet, was hurried away still higher than it had been perhaps before.

THE jets were made with inconceivable velocity, and those which escaped uninterrupted terminated in sharp points, and lost themselves in the air. The eruption, changing its form at every instant, and blending variously with the clouds of steam that surrounded it, continued for ten or twelve minutes; the water then subsided through the pipe, and disappeared.

THE eruptions of the Geyser succeed each other with some degree of regularity, but they are not equally violent, or of equal duration. Some lasted scarcely eight or ten, while others continued, with unabated violence, fifteen or eighteen minutes. Between the great eruptions, while the pipe and basin were filling, the water burst several times into the air to a considerable height. These partial jets, however, seldom exceeded a minute, and sometimes not a few seconds, in duration.

AFTER the eruption of it had been violent, the water sank into subterraneous caverns, and left the pipe quite empty. If the eruption had been moderate, the subsidence of the water was proportionably less. The first time the pipe was perfectly emptied, we sounded its depth, and found the bottom very rough and irregular. The pipe remains but a short time empty. After a few seconds, the water rushes into it again, with a bubbling noise, and during the time that it is rising in the pipe, it is frequently darted suddenly into the air to different heights, sometimes to two or three, sometimes sixty feet above the sides of the basin. By a surprise of this kind, while we were engaged measuring the diameter of the well, we had nearly been scalded; and although we were able to withdraw ourselves from the great body of water as it ascended, yet we remained exposed to the falling spray, which fortunately was so much cooled in the air as to do us no mischief.

Or

Of these jets we counted twenty in an hour and an half, during which the waters had filled the pipe and in part the basin. It then seemed oftentimes agitated, and boiled with great violence. The jets were more beautiful, and continued longer, as the quantity of water in the basin increased. The resistance being greater, their force was in some degree broken, and their form, more divided, produced a greater display of foam and vapour.

WHILE the pipe was filling, we threw into it several stones of considerable weight, which, whenever the water burst forth with any violence, were projected much higher than itself. These stones in falling were met by other columns of water, and amidst these they rose and fell-repeatedly. They were easily distinguished in the white foam, and contributed much to the novelty and beauty of this extraordinary phenomenon.

WHEN the basin was nearly full, these occasional eruptions were generally announced by shocks of the ground, similar to those preceding the great eruptions. Immediately after the shocks, the whole body of water in the basin heaved exceedingly; a violent ebullition then took place, and large waves spread themselves in circles from the centre, through which the column forced its way.

WHEN the water had been quiet in the basin for some time, the thermometer placed in it stood at 180° only, but immediately after an eruption it rose to 200° . We boiled a piece of salmon in it, which was exceedingly well tasted. Our cookery at Rykum had not been quite so successful.

THE water thrown out from the Geyser is joined at the bottom of the mound by that which flows from the spring called the roaring Geyser, formerly described. The stream produced by their united waters flows three or four hundred paces before it falls into the river, where its temperature is reduced to 72° . Even at this place it deposited much of the substances it contained; but during the whole of its course, the plants

growing

growing on its banks were covered with beautiful incrustations. Some of these we wished to preserve, but from their extreme delicacy they fell into pieces on every attempt to remove them.

THE situation of the new Geyzer * is in the same line from the foot of the hill with the great Geyzer. Its pipe is formed with equal regularity, and is six feet in diameter, and forty-six feet ten inches in depth. It does not open into a basin, but it is nearly surrounded by a rim or wall two feet high. After each eruption, the pipe is emptied, and the water returns gradually into it, as into that of the old Geyzer. During three hours nearly that the pipe is filling, the partial eruptions happen seldom, and do not rise very high; but the water boils the whole time, and often with great violence. The temperature of the waters after one of these eruptions, was constantly found to be 212° . Few incrustations are formed round this spring, excepting in the channel where the water flows from it.

THE great eruption is not preceded by any noise, like that of the great Geyzer. The water boils suddenly, or is heaved over the sides of the pipe; then subsiding a little, it bursts into the air with inconceivable violence. The column of water remains entire, until it reaches its extreme height, where it is shivered into the finest particles. Its direction was perpendicular, and greatest elevation 132 feet. Like the eruption of the old Geyzer, this consisted of several jets, succeeding each other

with

* BEFORE the month of June 1789, the year I visited Iceland, this spring had not played with any great degree of violence, at least for considerable time. (Indeed the formation of the pipe will not allow us to suppose, that its eruptions had at no former period been violent.) But in the month of June, this quarter of Iceland had suffered some very severe shocks of an earthquake; and it is not unlikely, that many of the cavities communicating with the bottom of the pipe, had been then enlarged, and new sources of water opened into them. The difference between the eruptions of this fountain, and those of the great Geyzer, may be accounted for from the circumstance of their being no basin over the pipe of the first, in which any water can be contained to interrupt the column as it rises. I should here state, that we could not discover any correspondence between the eruptions of the different springs.

with great rapidity. Whatever we threw into the well was hurled into the air with such swiftness that the eye could scarcely discern it *, and the division of the water at the extremity of the column was so minute, that the showers of spray which fell were cold. Towards the end of an eruption, when more steam than water rushed from the pipe, I ventured to hold my hand near the edge of the column, in the way of some of the divided particles of water, and found them tepid only. You may probably think this a rash experiment, and certainly it was so. But we had made our observations on the uniform direction of the column, and confided our safety in it. Once or twice, however, we had reason to think ourselves more fortunate in escaping, than prudent in avoiding, the danger which attended a too near approach to these eruptions of boiling water. During ten or fifteen minutes, the water continued to be thrown upwards with undiminished impetuosity. At the end of that period, the quantity became less, and at length, ceasing entirely, steam alone ascended. In one instance, the eruption continued thirty minutes. It seldom however exceeded twenty minutes, and sometimes was completed in fifteen minutes. The force with which the steam rises abates as the water sinks in the pipe, and when this is exhausted, that soon disappears.

I HAVE now, Sir, given you such a description of these celebrated fountains as was in my power. I hope that it will afford you some satisfaction, and I could wish that it might serve as an inducement to some curious enquirer into the history of nature to visit them, who shall have all the knowledge requisite for making such observations as are yet to be desired concerning them. I cannot flatter myself, that the description I have attempted of their eruptions will impress you with a just idea of their beauty. Sources of comparison are wanting, by which

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* Mr BAIN measured the height to which a stone was thrown up by one of these jets, and found it 129 feet. Some others rose considerably higher.

the portraiture of such extraordinary scenes can be assisted. Nature no where offers objects bearing a resemblance to them; and art, even in constructing the water-works of Versailles, has produced nothing that can at all illustrate the magnificent appearances of the Geyzer. All then that I hope for is, to have said so much as may enable you to complete in your imagination, the picture which I have only sketched. Imagination alone can supply the noise and motion which accompany such large bodies of water bursting from their confinement; and must be left to paint, what I have not been able to describe, the brilliancy of colouring, the purity of the spray, the quick change of effect, and the thousand varieties of form into which the clouds of steam, filling the atmosphere on every side, are rolled incessantly.

I HAVE avoided entering into any theory of the cause of these phenomena, that you may not suppose the account I give you has been biased by a favourite hypothesis. I have given you an accurate state of facts, and I leave to you the explanation of them. There cannot, however, be two opinions concerning the immediate cause which forces the water upwards. It is obviously the elasticity of steam endeavouring to free itself. In addition to this, the form of the cylinder through which the water rises, gives it that projectile force which carries it so high. Beyond this, it would not become me to hazard any opinion.

Of the antiquity of these springs I can say nothing, further than that they are mentioned as throwing up their waters to a great height by SAXO GRAMMATICUS, in the Preface to his History of Denmark, which was written in the twelfth century; but from the general features of the country, it is likely, that they have existed a great length of time. The operations of subterraneous heat seem indeed to be of great antiquity in Iceland, and the whole country probably owes its existence

istence to the fires which burn beneath its surface. Every hill proves, at least, with what violence these fires have acted for ages; and the terrible eruptions of lava, which burst from the mountains of Skaptefield in 1783, show that they are as yet far from being extinguished.

I am,

Dear Sir,

With great regard and esteem,

Your very obedient servant,

JOHN THO. STANLEY.

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U

VII.

VII. *On the ORIGIN and INVESTIGATION of PORISMS.* By
JOHN PLAYFAIR, F. R. S. EDIN. and Professor of Ma-
thematics in the University of EDINBURGH.

P A R T I.

[*Read April 2. 1792.*]

1. THE restoration of the ancient books of geometry would have been impossible, without the coincidence of two circumstances, of which, though the one is purely accidental, the other is essentially connected with the nature of the mathematical sciences. The first of these circumstances is the preservation of a short abstract of those books, drawn up by PAPPUS ALEXANDRINUS, together with a series of such *lemmata*, as he judged useful to facilitate the study of them. The second is, the *necessary connection* that takes place among the objects of every mathematical work, which, by excluding whatever is arbitrary, makes it possible to determine the whole course of an investigation, when only a few points in it are known. From the union of these circumstances, mathematics has enjoyed an advantage of which no other branch of knowledge can partake; and while the critic or the historian has only been able to lament the fate of those books of LIVY and TACITUS which are lost, the geometer has had the high satisfaction to behold the works of EUCLID and APOLLONIUS reviving under his hands.

2. THE first restorers of the ancient books were not, however, aware of the full extent of the work which they had undertaken.

dertaken. They thought it sufficient to demonstrate the propositions, which they knew from PAPPUS, to have been contained in those books ; but they did not follow the ancient method of investigation, and few of them appear to have had any idea of the elegant and simple analysis by which these propositions were originally discovered, and by which the Greek geometry was peculiarly distinguished.

AMONG these few, FERMAT and HALLEY are to be particularly remarked. The former, one of the greatest mathematicians of the last age, and a man in all respects of superior abilities, had very just notions of the geometrical analysis, and appears often abundantly skilful in the use of it ; yet in his restoration of the *Loci Plani*, it is remarkable, that in the most difficult propositions, he lays aside the analytical method, and contents himself with giving the synthetical demonstration. The latter, among the great number and variety of his literary occupations, found time for a most attentive study of the ancient mathematicians, and was an instance of, what experience shews to be much rarer than might be expected, a man equally well acquainted with the ancient and the modern geometry, and equally disposed to do justice to the merit of both. He restored the books of APOLLONIUS, on the problem *De Sectione Spatii*, according to the true principles of the ancient analysis.

THESE books, however, are but short, so that the first restoration of considerable extent that can be reckoned complete, is that of the *Loci Plani* by Dr SIMSON, published in 1749, which, if it differs at all from the work it is intended to replace, seems to do so only by its greater excellence. This much at least is certain, that the method of the ancient geometers does not appear to greater advantage in the most entire of their writings, than in the restoration above mentioned ; and that Dr SIMSON has often sacrificed the elegance to which his own analysis would have led, in order to tread more exactly in what

the *lemmata* of PAPPUS pointed out to him, as the tract which APOLLONIUS had pursued.

3. THERE was another subject, that of *Porisms*, the most intricate and enigmatical of any thing in the ancient geometry, which was still reserved to exercise the genius of Dr SIMSON, and to call forth that enthusiastic admiration of antiquity, and that unwearied perseverance in research, for which he was so peculiarly distinguished. A treatise in three books, which EUCLID had composed on Porisms, was lost, and all that remained concerning them was an abstract of that treatise, inserted by PAPPUS ALEXANDRINUS in his *Mathematical Collections*, in which, had it been entire, the geometers of later times would doubtless have found wherewithal to console themselves for the loss of the original work. But unfortunately it has suffered so much from the injuries of time, that all which we can immediately learn from it is, that the ancients put a high value on the propositions which they called porisms, and regarded them as a very important part of their analysis. The Porisms of EUCLID are there said to be, “Collectio artificio-“ sifima multarum rerum quæ spectant ad analysin diffici-“ liorum et generalium problematum *.” The curiosity, how- ever, which is excited by this encomium is quickly disappoint- ed ; for when PAPPUS proceeds to explain what a Porism is, he lays down two definitions of it, one of which is rejected by him as imperfect, while the other, which is stated as correct, is too vague and indefinite to convey any useful information.

THESE defects might nevertheless have been supplied, if the enumeration which he next gives of EUCLID's propositions had been entire ; but on account of the extreme brevity of his enunciations, and their reference to a diagram which is lost, and for the constructing of which no directions are given, they are all, except one, perfectly unintelligible. For these reasons, the fragment

* *Collectiones Math.* lib. vii. in init.

fragment in question is so obscure, that even to the learning and penetration of Dr HALLEY, it seemed impossible that it could ever be explained ; and he therefore concluded, after giving the Greek text with all possible correctness, and adding the Latin translation, " *Hactenus Porismatum descriptio nec mihi intellecta, nec lectori profutura. Neque aliter fieri potuit, tam ob defectum schematis cuius fit mentio, quam ob omissa quædam et transposita, vel aliter vitiata in propositionis generalis expositione, unde quid fibi velit PAPPUS haud mihi datum est conjicere. His adde dictionis modum nimis contractum, ac in re difficiili, qualis hæc est, minime usurpandum *.*"

4. IT is true, however, that before this time, FERMAT had attempted to explain the nature of Porisms, and not altogether without success †. Guiding his conjectures by the definition which PAPPUS censures as imperfect, because it defined porisms only " *ab accidente,*" viz. " *Porisma est quod deficit hypothese a Theoremate Locali,*" he formed to himself a tolerably just notion of these propositions, and illustrated his general description by examples that are in effect Porisms. But he was able to proceed no farther ; and he neither proved, that his notion of a Porism was the same with EUCLID's, nor attempted to restore, or explain any one of EUCLID's propositions ; much less did he suppose, that they were to be investigated by an analysis peculiar to themselves. And so imperfect indeed was this attempt, that the complete restoration of the Porisms was necessary to prove, that FERMAT had even approximated to the truth.

5. ALL this did not, however, deter Dr SIMSON from turning his thoughts to the same subject, which he appears to have done

* De sectione rationis, proem. p. 37.

† " *Porismatum EUCLIDEORUM renovata doctrina, et sub forma Iлагогes exhibita.*"
FERMAT Opera Varia, p. 116.

done very early, and long before the publication of the *Loci Plani* in 1749. The account he gives of his progress, and of the obstacles he encountered, will be always interesting to mathematicians. " Postquam vero apud PAPPUM legeram Poris-
 mata EUCLIDIS collectionem fuisse artificiosissimam multarum
 rerum, quæ spectant ad analysin difficiliorum et generalium
 problematum, magno desiderio tenebar, aliquid de iis cognos-
 cendi; quare sæpius et multis variisque viis tum PAPPI proposi-
 tionem generalem, mancam et imperfectam, tum primum lib. i.
 Porisma, quod solum ex omnibus in tribus libris integrum ad-
 "huc manet, intelligere et restituere conabar; frustra tamen,
 "nihil enim proficiebam. Cumque cogitationes de hac re
 "multum mihi temporis consumperint, atque molestæ admo-
 "dum evaserint, firmiter animum induxi hæc nunquam in
 "posterum investigare; præsertim cum optimus geometra
 "HALLEIUS spem omnem de iis intelligendis abjecisset. Un-
 "de quoties menti occurrebant, toties eas arcebam. Postea
 "tamen accidit, ut improvidum et propositi immemorem in-
 "vaserint, meque detinuerint donec tandem lux quædam efful-
 "serit, quæ spem mihi faciebat inveniendi saltem PAPPI pro-
 "positionem generalem, quam quidem multa investigatione
 "tandem restitui. Hæc autem paulo post una cum Porismate
 "primo lib. i. impressa est inter Transactiones Phil. anni 1723,
 "No. 177 *."

THE propositions here mentioned, as inserted in the Philosophical Transactions for 1723, are all that Dr SIMSON published on the subject of Porisms during his life, though he continued his investigations concerning them, and succeeded in restoring a great number of EUCLID's propositions, together with their analysis. The propositions thus restored form a part of that valuable edition of the posthumous works of this geometer which the mathematical world owes to the munificence of the late Earl STANHOPE.

6. THE

* Rob. SIMSON Op. reliqua, p. 319.

6. THE subject of Porisms is not, however, exhausted, nor is it yet placed in so clear a light as to need no farther illustration. It yet remains to enquire into the probable origin of these propositions, that is to say, into the steps by which the ancient geometers appear to have been led to the discovery of them. It remains also to point out the relations in which they stand to the other classes of geometrical truths ; to consider the species of analysis, whether geometrical or algebraical, that belongs to them ; and, if possible, to assign the reason why they have so long escaped the notice of modern mathematicians. It is to these points that the following observations are chiefly directed.

I BEGIN with describing the steps that appear to have led the ancient geometers to the discovery of Porisms ; and must here supply the want of express testimony by probable reasonings, such as are necessary, whenever we would trace remote discoveries to their sources, and which have more weight in mathematics than in any other of the sciences.

7. IT cannot be doubted, that it has been the solution of problems which, in all states of the mathematical sciences, has led to the discovery of most geometrical truths. The first mathematical enquiries, in particular, must have occurred in the form of questions, where something was given, and something required to be done ; and by the reasonings necessary to answer these questions, or to discover the relation between the things that were given, and those that were to be found, many truths were suggested, which came afterwards to be the subjects of separate demonstration. The number of these was the greater, that the ancient geometers always undertook the solution of problems with a scrupulous and minute attention, which would scarcely suffer any of the collateral truths to escape their observation. We know from the examples which they have left us, that they never considered a problem as resolved, till they had distinguished all its varieties, and evolved separately every different case
that

that could occur, carefully remarking whatever change might arise in the construction, from any change that was supposed to take place among the magnitudes which were given.

Now, as this cautious method of proceeding was not better calculated to avoid error, than to lay hold of every truth that was connected with the main object of enquiry, these geometers soon observed, that there were many problems which, in certain circumstances, would admit of no solution whatever, and that the general construction by which they were resolved would fail, in consequence of a particular relation being supposed among the quantities which were given. Such problems were then said to become impossible ; and it was readily perceived, that this always happened, when one of the conditions prescribed was inconsistent with the rest, so that the supposition of their being united in the same *subject*, involved a contradiction. Thus, when it was required to divide a given line, so that the rectangle under its segments, should be equal to a given space, it was evident, that if this space was greater than the square of half the given line, the thing required could not possibly be done ; the two conditions, the one defining the magnitude of the line, and the other that of the rectangle under its segments, being then inconsistent with one another. Hence an infinity of beautiful propositions concerning the *maxima* and the *minima* of quantities, or the limits of the possible relations which quantities may stand in to one another.

8. SUCH cases as these would occur even in the solution of the simplest problems ; but when geometers proceeded to the analysis of such as were more complicated, they must have remarked, that their constructions would sometimes fail, for a reason directly contrary to that which has now been assigned. Instances would be found where the lines that, by their intersection, were to determine the thing sought, instead of intersecting one another, as they did in general, or of not meeting at all, as in the above mentioned case of impossibility, would coincide with

with one another entirely, and leave the question of consequence unresolved. But though this circumstance must have created considerable embarrassment to the geometers who first observed it, as being perhaps the only instance in which the language of their own science had yet appeared to them ambiguous or obscure, it would not probably be long till they found out the true interpretation to be put on it. After a little reflection, they would conclude, that since, in the general problem, the magnitude required was determined by the intersection of the two lines above mentioned, that is to say, by the points common to them both; so, in the case of their coincidence, as all their points were in common, every one of these points must afford a solution; which solutions therefore must be infinite in number; and also, though infinite in number, they must all be related to one another, and to the things given, by certain laws, which the position of the two coinciding lines must necessarily determine.

ON enquiring farther into the peculiarity in the state of the data which had produced this unexpected result, it might likewise be remarked, that the whole proceeded from one of the conditions of the problem involving another, or necessarily including it; so that they both together made in fact but one, and did not leave a sufficient number of independent conditions, to confine the problem to a single solution, or to any determinate number of solutions. It was not difficult afterwards to perceive, that these cases of problems formed very curious propositions, of an intermediate nature between problems and theorems, and that they admitted of being enunciated separately, in a manner peculiarly elegant and concise. It was to such propositions, so enunciated, that the ancient geometers gave the name of *Porisms*.

9. THIS deduction requires to be illustrated by examples. Suppose therefore that it is proposed to resolve the following problem:

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PROP.

PROP. L PROB. FIG. I.

A CIRCLE A B C, a straight line D E, and a point F, being given in position, to find a point G in the straight line D E, such that G F, the line drawn from it to the given point, shall be equal to G B, the line drawn from it touching the given circle.

SUPPOSE the point G to be found, and G B to be drawn touching the circle A B C in B; let H be the centre of the circle A B C; join H B, and let H D be perpendicular to D E; from D draw D L, touching the circle A B C in L, and join H L. Also from the centre G, with the distance G B or G F, describe the circle B K F, meeting H D in the points K and K'.

It is plain, that the lines H D and D L are given in position and in magnitude. Also, because G B touches the circle A B C, H B G is a right-angle; and since G is the centre of the circle B K F, therefore H B touches the circle B K F, and consequently the square of H B, or of H L, is equal to the rectangle K' H K. But the rectangle K' H K, together with the square of D K, is equal to the square of D H, because K K' is bisected in D; therefore the squares of H L and D K are also equal to the square of D H. But the squares of H L and L D are equal to the same square of D H; wherefore the square of D K is equal to the square of D L, and the line D K to the line D L. But D L is given in magnitude; therefore D K is given in magnitude, and K is therefore a given point. For the same reason, K' is a given point, and the point F being also given by hypothesis, the circle B K F is given in position. The point G therefore, the centre of the circle B K F is given, which was to be found.

HENCE

HENCE this construction : Having drawn HD perpendicular to DE , and DL touching the circle ABC , make DK and DK' each equal to DL , and find G the centre of a circle described through the points K , F and K' ; that is, let FK' be joined, and bisected at right angles by the line MN , which meets DE in G ; G will be the point required, or it will be such a point, that if GB be drawn from it, touching the circle ABC , and GF to the given point, GB and GF will be equal to one another *.

THE synthetical demonstration needs not be added ; but it is necessary to remark, that there are cases in which this construction fails altogether.

FOR, first, if the given point F be any where in the line HD , as at F' , it is evident, that MN becomes parallel to DE , and that the point G is no where to be found, or, in other words, is at an infinite distance from D .

THIS is true in general ; but if the given point F coincide with K , then the line MN evidently coincides with DE ; so that, agreeably to a remark already made, every point of the line DE may be taken for G , and will satisfy the conditions of the problem ; that is to say, GB will be equal to GK , wherever the point G be taken in the line DE . The same is true if F coincide with K' .

THIS is easily demonstrated synthetically ; for if G be any point whatsoever in the line DE , from which GB is drawn touching the circle ABC ; if DK and DK' be each made equal to DL ; and if a circle be described through the points B , K , and K' ; then, since the rectangle KHK' , together with the square of DK , that is, of DL , is equal to the square of

X 2 D H,

* This solution of the problem was suggested to me by Professor ROBISON ; and is more simple than that which I had originally given.

DH, that is, to the squares of DL and LH, the rectangle KH K' is equal to the square of HB, so that HB touches the circle BK K' . But BG is at right-angles to HB; therefore the centre of the circle BK K' is in the line BG; and it is also in the line DE; therefore G is the centre of the circle BK K' , and GB is equal to GK.

THUS we have an instance of a problem, and that too a very simple one, which is in general determinate, admitting only of one solution, but which nevertheless, in one particular case, where a certain relation takes place among the things given, becomes indefinite, and admits of innumerable solutions. The proposition which results from this case of the problem is a Porism, according to the remarks that were made above, and in effect will be found to coincide with the 66th proposition in Dr SIMSON's Restoration. It may be thus enunciated: "A circle ABC being given in position, and also a straight line DE, which does not cut the circle, a point K may be found, such that if G be any point whatever in the line DE, the straight line drawn from G to the point K, shall be equal to the straight line drawn from G, touching the circle ABC."

10. THE following Porism is also derived in the same manner from the solution of a very simple problem:

PROP. II. PROB. FIG. 2.

A TRIANGLE ABC being given, and also a point D, to draw through D a straight line DG, such, that, perpendiculars being drawn to it from the three angles of the triangle, viz. AE, BG, CF, the sum of the two perpendiculars on the same side of DG, shall be equal to the remaining

maining perpendicular ; or, that A E and B G together, may be equal to C F.

SUPPOSE it done : Bisect A B in H, join C H, and draw H K perpendicular to D G.

BECAUSE A B is bisected in H, the two perpendiculars A E and B G are together double of H K ; and as they are also equal to C F by hypothesis, C F must be double of H K, and C L of L H. Now, C H is given in position and magnitude ; therefore the point L is given ; and the point D being also given, the line D L is given in position, which was to be found.

THE construction is obvious. Bisect A B in H, join C H, and take H L equal to one third of C H ; the straight line which joins the points D and L is the line required.

Now, it is plain, that while the triangle A B C remains the same, the point L also remains the same, wherever the point D may be. The point D may therefore coincide with L ; and when this happens, the position of the line to be drawn is left undetermined ; that is to say, any line whatever drawn through L will satisfy the conditions of the problem.

HERE therefore we have another indefinite case of a problem, and of consequence another Porism, which may be thus enunciated : "A triangle being given in position, a point in it may be found, such, that any straight line whatever being drawn through that point, the perpendiculars drawn to this straight line from the two angles of the triangle which are on one side of it, will be together equal to the perpendicular that is drawn to the same line from the angle on the other side of it."

II. THIS Porism may be made much more general ; for if, instead of the angles of a triangle, we suppose ever so many points to be given in a plane, a point may be found, such, that any straight line being drawn through it, the sum of all the perpendiculars that fall on that line from the given points on

one

one side of it, is equal to the sum of the perpendiculars that fall on it from all the points on the other side of it.

OR still more generally, any number of points being given not in the same plane, a point may be found, through which if any plane be supposed to pass, the sum of all the perpendiculars which fall on that plane from the points on one side of it, is equal to the sum of all the perpendiculars that fall on the same plane from the points on the other side of it.

IT is unnecessary to observe, that the point to be found in these propositions, is no other than the centre of gravity of the given points ; and that therefore we have here an example of a Porism very well known to the modern geometers, though not distinguished by them from other theorems.

12. THE problem which follows appears to have led to the discovery of more than one Porism.

P R O P. III. P R O B. FIG. 3.

A CIRCLE A B C, and two points D and E, in a diameter of it being given, to find a point F in the circumference of the given circle, from which, if straight lines be drawn to the given points E and D, these straight lines shall have to one another the given ratio of α to β *.

SUPPOSE the problem resolved, and that F is found, so that FE has to FD the given ratio of α to β . Produce EF any how to B, bisect the angle EFD by the line FL, and the angle DFB by the line FM.

THEN, because the angle EFD is bisected by FL, EL is to LD as EF to FD, that is, in a given ratio; and as ED is given, each of the segments EL, LD, is given, and also the point L.

AGAIN,

* The ratio of α to β is supposed that of a greater to a less.

AGAIN, because the angle DFB is bisected by FM, EM is to MD as EF to FD, that is, in a given ratio; and therefore, since ED is given, EM, MD, are also given, and likewise the point M.

BUT because the angle LFD is half of the angle EFD, and the angle DFM half of the angle DFB, the two angles LFD, DFM, are equal to the half of two right angles, that is, to a right angle. The angle LFM being therefore a right angle, and the points L and M being given, the point F is in the circumference of a circle described on the diameter LM, and consequently given in position.

Now, the point F is also in the circumference of the given circle ABC; it is therefore in the intersection of two given circumferences, and therefore is found.

HENCE this construction: Divide ED in L, so that EL may be to LD in the given ratio of α to β ; and produce ED also to M, so that EM may be to MD in the same given ratio of α to β . Bisect LM in N, and from the centre N, with the distance NL, describe the semicircle LFM, and the point F, in which it intersects the circle ABC, is the point required, or that from which FE and FD are to be drawn.

THE synthetical demonstration follows so readily from the preceding analysis, that it is not necessary to be added.

IT must however be remarked, that the construction fails when the circle LFM falls either wholly without, or wholly within the circle ABC, so that the circumferences do not intersect; and in these cases the solution is impossible. It is plain also, that in another case the construction will fail, viz. when it so happens that the circumference LFM wholly coincides with the circumference ABC. In this case, it is farther evident, that every point in the circumference ABC will answer the conditions of the problem, which therefore admits of innumerable solutions, and may, as in the foregoing instances, be converted into a Porism.

13. WE are therefore to enquire, in what circumstances the point L may coincide with the point A, and the point M with the point C, and of consequence the circumference L F M with the circumference A B C.

ON the supposition that they coincide, E A is to A D, and also E C to C D, as α to β ; and therefore E A is to E C as A D to C D, or, by conversion, E A to A C as A D to the excess of C D above A D, or to twice D O, O being the centre of the circle A B C. Therefore also, E A is to A O, or the half of A C, as A D to D O, and E A together with A O, to A O, as A D together with D O, to D O; that is, E O to A O as A O to D O, and so the rectangle E O. O D equal to the square of A O.

HENCE, if the situation of the given points E and D, (fig. 4.) in respect of the circle A B C, be such, that the rectangle E O. O D is equal to the square of A O, the semidiameter of the circle; and if, at the same time, the given ratio of α to β be the same with that of E A to A D, or of E C to C D, the problem admits of innumerable solutions; and as it is manifest, that if the circle A B C, and one of the points D or E be given, the other point, and also the ratio which is required to render the problem indefinite, may be found, therefore we have this Porism: "A circle A B C being given, and also a point D, a point E may be found, such, that the two lines inflected from these points to any point whatever in the circumference A B C, shall have to one another a given ratio, which ratio is also to be found."

THIS Porism is the second in the treatise *De Porismatibus*, where Dr SIMSON gives it, not as one of EUCLID's propositions, but as an illustration of his own definition. It answers equally well for the purpose I have here in view, the explaining the origin of Porisms; and I have been the more willing to introduce it, that it has afforded me an opportunity of giving what seems to be the simplest investigation of the second proposition in the second book of the *Loci Plani*, by proving, as has been done

above,

above, that on the hypothesis of that proposition, $L F M$ (fig. 3.) is a right angle, and L and M given points.

14. HENCE also an example of the derivation of Porisms from one another. For the circle $A B C$, and the points E and D , remaining as in the last construction, (fig. 4.) if through D we draw any line whatever $H D B$, meeting the circle in B and H , and if the lines $E B$, $E H$ be also drawn, these lines will cut off equal circumferences $B F$ and $H G$. Let $F C$ be drawn, and it is plain from the foregoing analysis, that the angles $D F C$, $C F B$ are equal. Therefore if $O G$, $O B$ be drawn, the angles $B O C$, $C O G$ are equal, and consequently the angles $D O B$, $D O G$. In the same manner, by joining $A B$, the angle $D B E$ being bisected by $B A$, it is evident, that the angle $A O F$ is equal to the angle $A O H$, and therefore the angle $F O B$ to the angle $H O G$, that is, the arch $F B$ to the arch $H G$.

Now, it is plain, that if the circle $A B C$, and one of the points D or E be given, the other point may be found; therefore we have this Porism, which appears to have been the last but one in the third book of EUCLID's Porisms*. "A point being given, either without or within a circle given in position, if there be drawn, any how through that point, a line cutting the circle in two points; another point may be found; such, that if two lines be drawn from it to the points, in which the line already drawn cuts the circle, these two lines will cut off from the circle equal circumferences."

THERE are other Porisms that may be deduced from the same original problem, (§ 12.) all connected, as many remarkable properties of the circle are, with the *harmonical division* of the diameter.

15. THE preceding proposition also affords a good illustration of the general remark that was made above, concerning the conditions of a problem being involved in one another, in the Porismatic, or indefinite case. Thus, several independent conditions are here laid down, by help of which the problem is to

be resolved : Two points D and E are given, (fig. 3.) from which two lines are to be inflected, and a circumference A BC, in which these lines are to meet, as also a ratio, which they are to have to one another *. Now, these conditions are all independent of each other, so that any one of them may be changed, without any change whatever in the rest. This at least is true in general ; but nevertheless in one case, *viz.* when the given points are so related to one another, that the rectangle under their distances from the centre, is equal to the square of the radius of the circle, it follows from the foregoing analysis, that the ratio which the inflected lines are to have to one another, is no longer a matter of choice, but is a necessary consequence of this disposition of the points. For if any other ratio were now assigned than that of A O to O D, or, which is the same, of E A to A D, it would easily be shewn, that no lines having that ratio could be inflected from the points E and D, to any point in the circle A B C. Two of the conditions are therefore reduced into one ; and hence it is that the problem is indefinite.

16. FROM this account of the origin of Porisms, it follows, that a Porism may be defined, *A proposition affirming the possibility of finding such conditions as will render a certain problem indeterminate, or capable of innumerable solutions.*

To this definition, the different characters which PAPPUS has given will apply without difficulty. The propositions described in it, like those which he mentions, are, strictly speaking, neither theorems nor problems, but of an intermediate nature between both ; for they neither simply enunciate a truth to be demonstrated, nor propose a question to be resolved ; but are affirmations of a truth, in which the determination of an unknown quantity is involved. In as far therefore as they assert, that a certain problem may become indeterminate, they are of the nature of theorems ; and in as far as they seek to discover

the

* The given points, and the centre of the given circle, are understood, throughout, to be in the same straight line.

the conditions by which that is brought about, they are of the nature of problems.

17. IN the preceding definition also, and the instances from which it is deduced, we may trace that imperfect description of Porisms which PAPPUS ascribes to the later geometers, *viz.* "Porisma est quod deficit hypothesi a theoremate locali." Now, to understand this, it must be observed, that if we take the converse of one of the propositions called *Loci*, and make the construction of the figure a part of the hypothesis, we have what was called by the ancients a Local Theorem. And again, if, in enunciating this theorem, that part of the hypothesis which contains the construction be suppressed, the proposition arising from thence will be a Porism; for it will enunciate a truth, and will also require, to the full understanding and investigation of that truth, that something should be found, *viz.* the circumstances in the construction, supposed to be omitted.

THUS, when we say; If from two given points E and D, (fig. 4.) two lines E F and F D are inflected to a third point F, so as to be to one another in a given ratio, the point F is in the circumference of a circle given in position: we have a *Locus*.

BUT when conversely it is said; If a circle A B C, of which the centre is O, be given in position, as also a point E, and if D be taken in the line E O, so that the rectangle E O. O D be equal to the square of A O, the semidiameter of the circle; and if from E and D, the lines E F and D F be inflected to any point whatever in the circumference A B C; the ratio of E F to D F will be a given ratio, and the same with that of E A to A D: we have a local theorem.

AND, lastly, when it is said; If a circle A B C be given in position, and also a point E, a point D may be found, such, that if the two lines E F and F D be inflected from E and D to any point whatever F, in the circumference, these lines shall

have a given ratio to one another: the proposition becomes a Porism, and is the same that has been just investigated.

HERE it is evident, that the local theorem is changed into a Porism, by leaving out what relates to the determination of the point D, and of the given ratio. But though all propositions formed in this way, from the conversion of *Loci*, be Porisms, yet all Porisms are not formed from the conversion of *Loci*. The first and second of the preceding, for instance, cannot by conversion be changed into *Loci*; and therefore the definition which describes all Porisms as being so convertible, is not sufficiently comprehensive. FERMAT's idea of Porisms, as has been already observed, was founded wholly on this definition, and therefore could not fail to be imperfect.

18. IT appears, therefore, that the definition of Porisms given above, (§ 16.) agrees with PAPPUS's idea of these propositions, as far at least as can be collected from the imperfect fragment which contains his general description of them. It agrees also with Dr SIMSON's definition, which is this * : " Po-
" risma est propositio in qua proponitur demonstrare rem ali-
" quam, vel plures datas esse, cui, vel quibus, ut et cuilibet ex
" rebus innumeris, non quidem datis, sed quæ ad ea quæ data
" sunt eandem habent relationem, convenire ostendendum est
" affectionem quandam communem in propositione descrip-
" tam."

IT cannot be denied, that there is a considerable degree of obscurity in this definition †; notwithstanding of which, it is certain,

* SIMSON's Opera Reliqua, p. 323.

† THE following translation will perhaps be found to remedy some of the obscurity complained of.

" A PORISM is a proposition, in which it is proposed to demonstrate, that one or more things are given, between which and every one of innumerable other things, not given, but assumed according to a given law, a certain relation, described in the proposition, is to be shewn to take place."

certain, that every proposition to which it applies must contain a problematical part, *viz.* "in qua proponitur demonstrare rem aliquam, vel plures datas esse;" and also a theoretical part, which contains the property, or *communis affectio*, affirmed of certain things which have been previously described.

IT is also evident, that the subject of every such proposition is the relation between magnitudes of three different kinds; determinate magnitudes, which are given; determinate magnitudes, which are to be found; and indeterminate magnitudes, which, though unlimited in number, are connected with the others by some common property. Now, these are exactly the conditions contained in the definition that has been given here.

19. To confirm the truth of this theory of the origin of Porisms, or at least the justness of the notions founded on it, I must add a quotation from an Essay on the same subject, by a member of this Society, the extent and correctness of whose views make every coincidence with his opinions peculiarly flattering. In a paper read several years ago before the Philosophical Society, Professor DUGALD STEWART defined a Porism to be, "A proposition affirming the possibility of finding one or more of the conditions of an indeterminate theorem;" where, by an indeterminate theorem, as he had previously explained it, is meant one which expresses a relation between certain quantities that are determinate, and certain others that are indeterminate, both in magnitude and in number. The near agreement of this with the definition and explanations which have been given above, is too obvious to require

It may be proper to remark, that there is an ambiguity in the word *given*, as used here and on many other occasions, where it denotes indifferently things that are both *determinate* and *known*, and things that, though *determinate*, are *unknown*, provided they can be found. This holds as to the first application of the term in the above definition; from which however no inconvenience arises, when the reader is apprised of it. In the course of this paper, I have endeavoured, as much as possible, to avoid the like ambiguity.

quire to be pointed out; and I have only to observe, that it was not long after the publication of SIMSON's posthumous works, when, being both of us occupied in speculations concerning Porisms, we were led separately to the conclusions which I have now stated *.

20. WE

* In an enquiry into the origin of Porisms, the etymology of the term ought not to be forgotten. The question indeed is not about the derivation of the word Πορίσμα, for concerning that there is no doubt; but about the reason why this term was applied to the class of propositions above described. Two opinions may be formed on this subject, and each of them with considerable probability.

1mo, ONE of the significations of $\pi\omega\gamma\zeta\omega$, is to acquire or obtain; and hence Πορίσμα, the thing obtained or gained. Accordingly, SCAPULA says, *Est vox a geometris desumpta qui theorema aliquid ex demonstrativo syllogismo necessario sequens inferentes, illud quaf lucrari dicuntur, quod non ex professo quidem theorematis bujus instituta fit demonstratio, sed tamen ex demonstratis recte sequatur.* In this sense, EUCLID uses the word in his Elements of Geometry, where he calls the corollaries of his propositions, *Porismata*. This circumstance creates a presumption, that when the word was applied to a particular class of propositions, it was meant, in both cases, to convey nearly the same idea, as it is not at all probable, that so correct a writer as EUCLID, and so scrupulous in his use of words, should employ the same term to express two ideas which are perfectly different. May we not therefore conjecture, that these propositions got the name of Porisms, entirely with a reference to their origin. According to the idea explained above, they would in general occur to mathematicians when engaged in the solution of the more difficult problems, and would arise from those particular cases, where one of the conditions of the data involved in it some one of the rest. Thus, a particular kind of theorem would be obtained, following as a corollary from the solution of the problem; and to this theorem the term Πορίσμα might be very properly applied, since, in the words of SCAPULA, already quoted, *Non ex professo theoremati bujus instituta fit demonstratio, sed tamen ex demonstratis recte sequatur.*

2do, But though this interpretation agrees so well with the supposed origin of Porisms, it is not free from difficulty. The verb $\pi\omega\gamma\zeta\omega$ has another signification, to find out, to discover, to devise; and is used in this sense by PAPPUS, when he says, that the propositions called Porisms, afford great delight, τοις δυναμούσις οἷαι καὶ πωγίαι, to those who are able to understand and INVESTIGATE. Hence comes πωγίαι, the art of finding out, or discovering, and from πωγίαι, in this sense, the same author evidently considers Πορίσμα as being derived. His words are, Εφασαν δὲ (ἢ αρχαῖ) Πορίσμα εἴαι το προτείνουσιν εἰς Πορίσμαν αὐτὰ τα προτείνουσα, the ancients said, that a Porism is something proposed for the FINDING OUT, or DISCOVERING of the very thing proposed. It seems singular, however, that Porisms should have taken their name from a circumstance common to them with so many other geometrical truths; and if this was really the case, it must have been on account of the enigmatical form of their enunciation, which required, that in the analysis of these propositions, a sort of double discovery should be made, not only of the TRUTH, but also of the MEANING of the very thing which was proposed. They may therefore have been called *Porismata* or *Investigations*, by way of eminence.

20. WE might next proceed to consider the particular Porisms which Dr SIMSON has restored, and to shew, that every one of them is the indeterminate case of some problem. But of this it is so easy for any one, who has attended to the preceding remarks, to satisfy himself, by barely examining the enunciations of those propositions, that the detail into which it would lead seems to be unnecessary. I shall therefore go on to make some observations on that kind of *analysis* which is particularly adapted to the investigation of Porisms.

If the idea which we have given of these propositions be just, it follows, that they are always to be discovered, by considering the cases in which the construction of a problem fails, in consequence of the lines which, by their intersection, or the points which, by their position, were to determine the magnitude required, happening to coincide with one another. A Porism may therefore be deduced from the problem it belongs to, in the same manner that the propositions concerning the *maxima* and *minima* of quantities are deduced from the problems of which they form the limitations; and such no doubt is the most natural and most obvious analysis of which this class of propositions will admit.

IT is not, however, the only one that they will admit of; and there are good reasons for wishing to be provided with another, by means of which, a Porism that is any how suspected to exist, may be found out, independently of the general solution of the problem to which it belongs. Of these reasons, one is, that the Porism may perhaps admit of being investigated more easily than the general problem admits of being resolved; and another is, that the former, in almost every case, helps to discover the simplest and most elegant solution that can be given of the latter.

THE truth of this last observation has been already exemplified in two of the preceding problems, where the Porismatic case, by determining the point K in the first, and L in the second

second of them, became necessary to the general solution. In more difficult problems, the same will be found to hold still more remarkably, and this is evidently what PAPPUS had in view, when, in a passage already quoted, he called Porisms, “*Collectio artificiosissima multarum rerum quæ spectant ad analysin difficiliorum et generalium problematum.*”

ON this account, it is desirable to have a method of investigating Porisms, which does not require, that we should have previously resolved the problems they are connected with, and which may always serve to determine, whether to any given problem there be attached a Porism, or not. Dr SIMSON’s analysis may be considered as answering to this description; for as that geometer did not regard these propositions at all in the light that is done here, nor in relation to their origin, an independent analysis of this kind, was the only one that could occur to him; and he has accordingly given one which is extremely ingenious, and by no means easy to be invented, but which he uses with great skilfulness and dexterity throughout the whole of his Restoration.

IT is not easy to ascertain whether this be the precise method used by the ancients. Dr SIMSON had here nothing to direct him but his genius, and has the full merit of the first inventor. It seems probable, however, that there is at least a great affinity between the methods, since the *lemmata* given by PAPPUS as necessary to EUCLID’s demonstrations, are subservient also to those of our modern geometer.

21. I SHALL employ the same sort of analysis in the Porisms that follow, at least till we come to treat of them algebraically, where a method of investigating these propositions will present itself, which is perhaps more simple and direct than any other. The following Porism is the first of EUCLID’s, and the first also that was restored. It is given here to exemplify the advantage which, in investigations of this kind, may be derived from employing the *law of continuity* in its utmost extent,

extent, and pursuing Porisms to those extreme cases, where the indeterminate magnitudes increase *ad infinitum*; into which state Dr SIMSON probably did not think it safe to follow them, and was thereby deprived of no inconsiderable help toward the simplifying of his constructions. If therefore it can be shewn, that this help may be obtained without any sacrifice of geometrical accuracy, it will be some improvement in this branch of the analysis.

THE Porism just mentioned may be considered as having occurred in the solution of a problem. Suppose it were required; two points A and B, (fig. 5.) and also three straight lines D E, F K, K L, being given in position, together with two points H and M, in two of these lines, to inflect from A and B to a point in the third line, two lines that shall cut off from K F and K L two segments, adjacent to the given points H and M, having to one another the given ratio of α to β .

Now, in order to find whether there be any Porism connected with this problem, suppose that there is, and that the following proposition is true.

PROP. IV. PORISM. FIG. 5.

22. Two points A and B, and two straight lines D E and F K, being given in position, and also a point H in one of them, a line L K may be found, and also a point in it M, both given in position, such, that A E and B E, inflected from the points A and B to any point whatsoever of the line D E, shall cut off from the other lines F K and L K, segments, H G and M N, adjacent to the given points H and M, having to one another the given ratio of α to β .

FIRST, let A E', B E' be inflected to the point E', so that A E' may be parallel to F K, then shall E' B be parallel to K L,

the line to be found. For if it be not parallel to K L, the point of their intersection must be at a finite distance from the point M, and therefore making as β to α , so this distance to a fourth proportional, the distance from H, at which A E' intersects F K, will be equal to that fourth proportional. But A E' does not intersect F K, for they are parallel by construction; therefore B E' cannot intersect K L; K L is therefore parallel to B E', a line given in position.

AGAIN, let A E'', B E'' be inflected to E'', so that A E'' may pass through the given point H; then it is plain, that B E'' must pass through the point to be found M; for if not, it may be demonstrated, just as has been done above, that A E'' does not pass through H, contrary to the supposition. The point to be found is therefore in the line E''B, which is given in position.

Now, if from E there be drawn E P parallel to A E', and E S parallel to B E', BS is to SE as BL to LN, and AP to PE as AF to FG; wherefore the ratio of FG to LN is compounded of the ratios of AF to BL, PE to SE, and BS to AP. But the ratio of PE to SE is the same with that of A E' to B E', and the ratio of BS to AP is the same with that of DB to DA, because DB is to BS as DE' to E' E, or as DA to AP. Therefore the ratio of FG to LN is compounded of the ratios of AF to BL, A E' to B E', and DB to DA.

IN like manner, because E'' is a point in the line D E, and A E'', B E'' are inflected to it, the ratio of FH to LM, is compounded of the same ratios of AF to BL, A E' to B E', and DB to DA; and therefore the ratio of FH to LM is the same with that of FG to NL, and the same consequently with that of HG to MN. But the ratio of HG to MN is given, being by supposition that of α to β ; the ratio of FH to LM is therefore also given, and FH being given, LM is given in magnitude.

magnitude. Now, $L M$ is parallel to $B E'$, a line given in position; therefore M is in a line QM parallel to $A B$, and given in position. But the point M is also in another line $B E''$ given in position; therefore the point M , and also the line $K L M$ drawn through it parallel to $B E'$, are given in position, which were to be found.

THE construction is thus: From A draw $A E'$ parallel to $F K$, meeting $D E$ in E' ; join $B E'$, and take in it $B Q$, so that as α to β so $H F$ to $B Q$ and through Q draw QM parallel to $A B$. Let $H A$ be drawn, and produced till it meet $D E$ in E'' , and let $B E''$ be drawn meeting QM in M . Through M draw $K M L$ parallel to $B E'$; then is $K M L$ the line, and M the point, which were to be found.

It is plain, that there are two lines which will answer the conditions of the Porism; for if in QB , produced on the other side of B , there be taken $B q$ equal to $B Q$; and if qm be drawn parallel to $A B$, intersecting $M B$ in m ; and if $m\lambda$ be drawn parallel to $B Q$, the part mn , cut off by $E B$ produced, will be equal to $M N$, and have to $H G$ the ratio required.

It is plain also, that whatever be the ratio of α to β , and whatever be the magnitude of $F H$, if the other things given remain the same, the lines found will be all parallel to $B E'$. But if the ratio of α to β remain the same likewise, and if only the point H vary, the position of $K L$ will remain the same, and the point M will vary.

23. THIS construction, from which, and the foregoing analysis, the synthetical demonstration follows readily, will be found to be more simple than Dr SIMSON's, owing entirely to the use that has been made of the *law of continuity* in the two extreme cases, where, according to the language of the modern analysis, $H G$ becomes infinite, in the one, and equal to nothing, in the other. Had it been affirmed, agreeably to that same language, that in the first of those cases, because of the constant

ratio of HG to MN, these lines must both become infinite at the same time, and in the second, that for the same reason they must both vanish at the same time, we might have been accused of departing from the strict form of reasoning employed in the ancient geometry. But when the thing is stated as above, and it is proved, that when AE' does not meet KF, it is impossible for BE' to meet ML; and again, that when AE'' passes through H, it is impossible for BE'' not to pass through M, the air of paradox is entirely removed, and the tracing of the law of continuity is rendered perfectly consistent with the utmost severity of geometrical demonstration.

Dr SIMSON has applied this Porism very ingeniously to the solution of the same problem from which it is here supposed to be derived *; and it is worthy of remark, that supposing the points A and B, and the lines DE and FK to be as in the figure of this Porism, if the third of the given lines be not parallel to BE', that problem can always be resolved, and admits of two solutions; but if it be parallel to BE', the problem either becomes impossible, or a Porism; that is, it either admits of no solution, or of an infinite number. We shall soon have occasion to extend the same observation to other Porisms.

ANOTHER general remark which I have to make on the analysis of Porisms is, that it frequently happens, as in the last example, that the magnitudes required may all, or a part of them, be found by considering the extreme cases; but for the discovery of the relation between them, and the indefinite magnitudes, or *res innumeræ*, we must have recourse to the hypothesis of the Porism in its most general, or indefinite form, and must endeavour so to conduct the reasoning that the indefinite magnitudes shall at length wholly disappear, and leave a proposition, containing only a relation of determinate magnitudes to one another. Now, in order to accomplish this. Dr

SIMSON

* *Opera Reliqua, de Porismatibus*, prop. 25.

SIMSON frequently employs two statements of the general hypothesis, which he compares together ; as for instance, in his analysis of the last Porism, he assumes, not only E , any point whatsoever in the line $D E$, but also another point O , any whatsoever in the same line, to both of which he supposes lines to be inflected from the given points A and B . This double statement, however, cannot be made, without rendering the investigation long and complicated ; and therefore it may be of use to remark, that it is never necessary, but may always be avoided by an appeal to simpler Porisms, or to *Loci*, or to the propositions of the *data*. I shall give the following Porism as an example, where this is done with some difficulty, but with considerable advantage, in regard to the simplicity and shortness of the investigation.

PROP. V. PORISM. FIG. 6.

24. LET there be three straight lines $A B$, $A C$, $C B$ given in position, and from any point whatsoever in one of them, as D , let perpendiculars be drawn to the other two, as $D F$, $D E$; a point G may be found, such, that if $G D$ be drawn from it to the point D , the square of that line shall have a given ratio to the sum of the squares of the perpendiculars $D F$ and $D E$, which ratio is to be found.

DRAW from A and B the lines $A H$, $B K$ at right angles to $B C$ and $C A$, and divide $A B$ in L , so that $A L$ may be to $L B$ in the given ratio of the square of $A H$ to the square of $B K$, or, which is the same, of the square of $A C$ to the square of $C B$. The point L is therefore given ; and if N be taken so as to have to $A L$ the same ratio that $A B^2$ has to $A H^2$, N will be given in magnitude. Also since $A H^2 : B K^2 :: A L : L B$,

and

and $A H^2 : A B^2 :: AL : N$, ex equo $B K^2 : A B^2 :: LB : N$. From L draw LO, LM perpendicular to AC, CB; LO and LM are given in magnitude.

Now, because $A B^2 : B K^2 :: AD^2 : DF^2$, $N : LB :: AD^2 : DF^2$, so that $DF^2 = \frac{LB}{N} \cdot AD^2$, and for the same reason, $DE^2 =$

$$\frac{AL}{N} \cdot BD^2. \quad \text{But } (Loci Plani, Append. Lem. 1.) \frac{LB}{N} \cdot AD^2 +$$

$$\frac{AL}{N} \cdot BD^2 = \frac{LB}{N} \cdot AL^2 + \frac{AL}{N} \cdot BL^2 + \frac{AB}{N} \cdot DL^2; \text{ that is,}$$

$$DE^2 + DF^2 = LO^2 + LM^2 + \frac{AB}{N} \cdot DL^2.$$

JOIN LG; then by hypothesis, $LO^2 + LM^2$ has to LG^2 the same ratio which $DF^2 + DE^2$ has to DG^2 ; and if this ratio be that of R to N, $LO^2 + LM^2 = \frac{R}{N} \cdot LG^2$; and therefore

$$DE^2 + DF^2 = \frac{R}{N} \cdot LG^2 + \frac{AB}{N} \cdot DL^2. \quad \text{But } DE^2 + DF^2 =$$

$$\frac{R}{N} \cdot DG^2; \text{ therefore } \frac{R}{N} \cdot LG^2 + \frac{AB}{N} \cdot DL^2 = \frac{R}{N} \cdot DG^2, \text{ and}$$

$$\frac{AB}{N} \cdot DL^2 = \frac{R}{N} (DG^2 - LG^2). \quad \text{The excess of the square of}$$

DG above the square of LG , has therefore a constant ratio to the square of DL , viz. that of AB to R . The angle DLG is therefore a right angle, and the ratio of AB to R , the ratio of equality, otherwise LD would be given in magnitude, which is contrary to the supposition. The line LG is therefore given in position; and since R is to N , that is, AB to N , as the squares of LO and LM to the square of LG , therefore the square of LG , and consequently the line LG , is given in magnitude. The point G is therefore given, and also the ratio of

of the squares of DE and DF to the square of DG , which is the same with that of AB to N .

HENCE this construction: Divide AB in L , so that AL may be to LB as the square of AH to the square of BK , and make as the square of AH to the square of AB , so AL to N ; and, lastly, having drawn from L upon AC and CB the perpendiculars LO and LM , make LG perpendicular to AB , and such, that as AB to N , so the sum of the squares of LO and LM to the square of LG ; G will be the point required, and the given ratio, which the squares on DF and DE have to the square on DG , will be that of AB to N .

THIS is the construction which follows most directly from the analysis; but it may be rendered more simple. For since $AH^2 : AB^2 :: AL : N$, and $BK^2 : AB^2 :: BL : N$, therefore $AH^2 + BK^2 : AB^2 :: AL + BL : N$. Likewise, if AG , BG be joined, $AB : N :: AH^2 : AG^2$, and $AB : N :: BK^2 : BG^2$; wherefore $AB : N :: AH^2 + BK^2 : AG^2 + BG^2$, that is, $AH^2 + BK^2 : AB^2 :: AG^2 + BG^2 : LG^2$, and $AG^2 + BG^2 = AB^2$. The angle AGB is therefore a right angle; and $AL : LG : LB$. If therefore AB be divided in L , as in the preceding construction; and if LG , a mean proportional between AL and LB , be placed at right angles to AB , G will be the point required.

Cor. IT is evident from the construction, that if at the points A and B we suppose weights to be placed that are as the squares of the sines of the angles CAB , CBA , L will be the centre of gravity of these weights. For AL is to LB as AC^2 to CB^2 , or inversely as the squares of the sines of the angles at A and B .

25. Now, the step in this analysis by which a second introduction of the general hypothesis is avoided, is that in which the angle GLD is concluded to be a right angle. This conclusion follows from the excess of the square of DG above the square of GL , having a given ratio to the square of LD , at the same time that LD is of no determinate magnitude. For,

if

if possible, let $G L D$ be obtuse, (fig. 7.) and let the perpendicular from G upon $A B$ meet $A B$ in V , which point V is therefore given. And since the excess of the square of $G D$ above the square of $L G$ is equal to the square of $L D$, together with twice the rectangle $D L V$, therefore by the supposition, the square of $L D$, together with twice the rectangle $D L V$, must have a given ratio to the square of $L D$; the ratio of the rectangle $D L V$ to the square of $L D$, that is, of $V L$ to $L D$, is therefore given, so that $V L$ being given in magnitude, $L D$ is also given. But this is contrary to the supposition, for $L D$ is indefinite by hypothesis; and therefore $G L D$ cannot be obtuse, nor any other than a right angle.

THE same conclusion that is here drawn immediately from the indetermination of $L D$, would be deduced, according to Dr SIMSON's method, by assuming another point D' , any how, and from the supposition, that the excess of $G D'^2$ above $G L^2$ was to $L D'^2$ in the same ratio that the excess of $G D^2$ above $G L^2$ is to $L D^2$, it would follow without much difficulty, that $G L D$ must be a right angle, and the given ratio, a ratio of equality. The method followed above is shorter and less intricate than this last, and has, I think, the advantage of discovering more plainly the *spirit* of the analysis, and the effect which the indefinite nature of the quantities, supposed indeterminate in the Porism, has in ascertaining the relation, that must subsist between the magnitudes that are given, and those that are to be found.

26. THIS Porism may be extended to any number of lines whatsoever, and may be thus enunciated: "Let there be any number of straight lines given in position, and from any point in one of them, let perpendiculars be drawn to all the rest, a point may be found, such, that the square of the line joining it, and the point from which the perpendiculars are drawn, shall have to the sum of the squares of these perpendiculars a given ratio, which ratio is also to be found."

THE

THE analysis of the Porism, when thus generalized, is too long to be given here*. We must not, however, omit to take notice, that the point L, where the perpendicular from the point to be found meets the line, from which the perpendiculars are drawn to the rest, is in all cases determined by the rule suggested in the corollary. (§ 24.) For if at the points in which the said line is intersected by the others, there be placed weights proportional to the squares of the sines of the angles of intersection, L will be the centre of gravity of these weights.

27. THESE Porisms facilitate the solution of the general problems from which they are derived. For if it were proposed, three straight lines AB, AC, BC being given in position, and also a point R, (fig. 6.) to find a point D in one of the given lines AB, such, that the sum of the squares of the perpendiculars drawn from D to the other two lines, should have a given ratio to the square of DR, it is plain, that the finding of the point G in the Porism, would render the construction easy. For the squares of RD and GD, having each given ratios to the sum of the squares of the perpendiculars drawn from D, have a given ratio to one another. The ratio of the lines, RD and GD themselves, is therefore given, and the points R and G being given, D is in the circumference of a circle given in position; and it is also in the straight line AB given in position; therefore it is given. The same holds, whatever be the number of lines given in position.

THE same Porisms assist also in the solution of another problem. For if it were proposed to find D, so that the sum

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of

* THIS Porism, in the case considered above, *viz.* when there are three straight lines given in position, was communicated to me several years ago, without any analysis or demonstration, by Dr. TRAIL, Prebendary of Lisburn in Ireland, who told me also, that he had met with it among some of Dr. SIMSON's papers, which had been put into his hands, at the time when the posthumous works of that geometer were preparing for the press. The application of it to the second of the problems, (§ 27.) was also suggested by Dr. TRAIL.

of the squares of the perpendiculars drawn from it to AC, and CB, should be equal to a given square, this would be done by finding G ; and then because the sum of the squares of the perpendiculars is given, and has a given ratio to the square of DG, DG will be given, and consequently the point D. This is also true, whatever be the number of the lines.

28. THE connection of the Porisms with the impossible cases of these problems, is abundantly evident ; the point L being that from which, if perpendiculars be drawn to AC and CB, the sum of their squares is the least possible. For since (fig. 6.) $DF^2+DE^2:DG^2::LO^2+LM^2:LG^2$, and since LG is less than DG, LO^2+LM^2 must be less than DF^2+DE^2 .

HENCE also a point Q may be found, from which, if perpendiculars be drawn to the sides of the triangle ABC, the sum of the squares of these perpendiculars is less than the sum of the squares of the perpendiculars drawn to the sides of the triangle from any other point.

FOR if ab (fig. 8.) be any line drawn parallel to AB, and if it be divided in λ , so that $a\lambda$ may be to λb in the duplicate ratio of aC to Cb , or of AC to CB, then of all the points in the line ab , λ is that from which, if perpendiculars be drawn to the lines AC, CB, the sum of their squares is the least possible. But since $a\lambda$ is to λb as the square of AC to the square of BC, that is, as AL to LB, therefore the *locus* of λ is the straight line LC, joining the given points L and C. The point to be found therefore, or that from which perpendiculars being drawn to the sides of the figure, the sum of their squares is the least possible, is in the straight line LC.

FOR let q be any point on either side of LC, and let the line ab be drawn through q parallel to AB, meeting LC in λ . then the sum of the squares of the perpendiculars from q upon AC, CB, is greater than the sum of the squares of the perpendiculars from λ upon the same lines. Therefore adding the square of the perpendicular from q , or λ , on AB, to both, the sum of the squares of the perpendiculars from q , will be greater than the

the sum of the squares of the perpendiculars from λ . The point, therefore, which makes the sum of the squares of the perpendiculars drawn from it, to the sides of the triangle ABC, a *minimum*, is not on either side of the line LC ; it is therefore in the line LC.

For the same reason, if AC be divided in L', so that AL' is to L'C as the square of AB to the square of BC, and if BL' be joined, the point to be found is in BL'. It is therefore in the point Q, where the lines CL and BL' intersect one another.

THE point Q, in any other figure, may be found nearly in the same manner. Let ABCD, for instance, (fig. 9.) be a quadrilateral figure ; let the opposite sides, AB and DC, be produced till they meet in E, and let ab be drawn parallel to AB, meeting CE in e, and let λ be the point in the line ab from which perpendiculars are drawn to the three lines BC, CD, DA, so that the sum of their squares is less, than if they were drawn from any other point, in the same line ; then if weights be placed at b, a and e, proportional to the squares of the sines of the angles Cba, bAD, aCD, λ is the centre of gravity of these weights. (§ 26.) Now, these weights having given ratios to one another, the *locus* of the point λ , from the known properties of the centre of gravity, is a straight line $L\lambda$, given in position. The point to be found is, therefore, in that line. For the same reason, it is in another straight line $L'\lambda'$ also given in position ; and therefore it is in Q, the point of their intersection.

THERE are many other remarkable properties of this point, which appear sometimes in the form of Porisms, and sometimes of theorems. Of the former, some curious instances will be found in Dr SMALL's Demonstrations of Dr STEWART's Theorems *. Of the latter, I shall only add one, omitting the demonstration, which would lead into too long a digression. " If Q be the point in a triangle from which perpendiculars are drawn to the sides of the triangle, so that the sum of their squares is the least possible ; twice the area of the triangle is a

A a 2

mean

* Transl. R. S. Edin. vol. ii. p. 112, &c.

mean proportional between the sum of the squares of the sides of the triangle, and the sum of the squares of the above mentioned perpendiculars."

29. BUT to return to the subject of Porisms: It is evident from what has now appeared, that in some instances at least, there is a close connection between these propositions and the *maxima* or *minima*, and, of consequence, the impossible cases, of problems. The nature of this connection requires to be further investigated, and is the more interesting, that the transition from the indefinite, to the impossible cases of a problem seems to be made with wonderful rapidity. Thus, in the first proposition, though there be not, properly speaking, an impossible case, but only one where the point to be found goes off *ad infinitum*, we may remark, that if the given point F be anywhere out of the line HD, the problem of drawing GB equal to GF is always possible, and admits just of one solution; but if F be in the line DH, the problem admits of no solution at all, the point being then at an infinite distance, and therefore impossible to be assigned. There is however this exception, that if the given point be at K, in this same line DH, determined by making DK equal to DL, then every point in the line DE gives a solution, and may be taken for the point G. Here therefore the case of innumerable solutions, and the case of no solution, are as it were *conterminal*, and so close to one another, that if the given point be at K, the problem is indefinite, but that if it remove ever so little from K, remaining at the same time in the line DH, the problem cannot be resolved.

I HAD observed this remarkable affinity between cases, which in other respects are diametrically opposite, in a great variety of instances, before I perceived the reason of it, and found, that by attending to the origin which has been assigned to Porisms, I ought to have discovered it *a priori*. It is, as we have seen, a general principle, that a problem is converted into a Porism, when one, or when two, of the conditions of it, necessarily involve in them some one of the rest. Suppose then that two of

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the conditions are exactly in that state, which determines the third; then, while they remain fixed, or given, should that third one be supposed to vary, or differ, ever so little, from the state required by the other two, a contradiction will ensue. Therefore if, in the hypothesis of a problem, the conditions be so related to one another as to render it indeterminate, a Porism is produced; but if, of the conditions thus related to one another, some one be supposed to vary, while the others continue the same, an absurdity follows, and the problem becomes impossible. *Wherever therefore any problem admits both of an indeterminate, and an impossible case, it is certain, that these cases are nearly related to one another, and that some of the conditions by which they are produced, are common to both.* This affinity, which seems to be one of the most remarkable circumstances respecting Porisms, will be more fully illustrated, when we treat of the algebraic investigation of these propositions.

30. It is supposed above, that *two* of the conditions of a problem involve in them a third, and wherever that happens, the conclusion which has been deduced will invariably take place. But a Porism may sometimes be so simple, as to arise from the mere coincidence of *one* condition of a problem with another, though in no case whatever, any inconsistency can take place between them. Thus, in the second of the foregoing propositions, the coincidence of the point given in the problem with another point, *viz.* the centre of gravity of the given triangle, renders the problem indeterminate; but as there is no relation of distance, or position, between these points, that may not exist, so the problem has no impossible case belonging to it. There are, however, comparatively but few Porisms so simple in their origin as this, or that arise from problems in which the conditions are so little complicated; for it usually happens, that a problem which can become indefinite, may also become impossible; and if so, the connection between these cases, which has been already explained, never fails to take place.

31. ANOTHER species of impossibility may frequently arise from the porismatic case of a problem, which will very much affect the application of geometry to astronomy, or any of the sciences of experiment, or observation. For when a problem is to be resolved by help of data furnished by experiment or observation, the first thing to be considered is, whether the data so obtained, be sufficient for determining the thing sought; and in this a very erroneous judgment may be formed, if we rest satisfied with a general view of the subject: For though the problem may in general be resolved from the data that we are provided with, yet these data may be so related to one another in the case before us, that the problem will become indeterminate, and instead of one solution, will admit of an infinite number.

SUPPOSE, for instance, that it were required to determine the position of a point F, (fig. 4.) from knowing that it was situated in the circumference of a given circle ABC, and also from knowing the ratio of its distances from two given points E and D; it is certain, that in general these data would be sufficient for determining the situation of F: But nevertheless, if E and D should be so situated, that they were in the same straight line with the centre of the given circle; and if the rectangle under their distances from that centre, were also equal to the square of the radius of the circle, then, as was shewn above, (§ 12.) the position of F could not be determined.

THIS particular instance may not indeed occur in any of the practical applications of geometry; but there is one of the same kind which has actually occurred in astronomy: And as the history of it is not a little singular, affording besides an excellent illustration of the nature of Porisms, I hope to be excused for entering into the following detail concerning it.

32. Sir ISAAC NEWTON having demonstrated, that the trajectory of a comet is a parabola, reduced the actual determination

tion of the orbit of any particular comet, to the solution of a geometrical problem, depending on the properties of the parabola, but of such considerable difficulty, that it is necessary to take the assistance of a more elementary problem, in order to find, at least nearly, the distance of the comet from the earth, at the times when it was observed. The expedient for this purpose, suggested by NEWTON himself, was to consider a small part of the comet's path as rectilineal, and described with an uniform motion, so that four observations of the comet being made at moderate intervals of time from one another, four straight lines would be determined, *viz.* the four lines joining the places of the earth and the comet, at the times of observation, across which if a straight line were drawn, so as to be cut by them into three parts, in the same ratios with the intervals of time above mentioned; the line so drawn would nearly represent the comet's path, and by its intersection with the given lines, would determine, at least nearly, the distances of the comet from the earth, at the times of observation.

THE geometrical problem here employed, of drawing a line to be divided by four other lines given in position, into parts having given ratios to one another, had been already resolved by Dr WALLIS and Sir CHRISTOPHER WREN, and to their solutions Sir ISAAC NEWTON added three others of his own, in different parts of his works. Yet none of all these geometers observed that peculiarity in the problem which rendered it inapplicable to astronomy. This was first done by M. BOSCOVICH, but not till after many trials, when, on its application to the motion of comets, it had never led to any satisfactory result. The errors it produced in some instances were so considerable, that ZANOTTI, seeking to determine by it the orbit of the comet of 1739, found, that his construction threw the comet on the side of the sun opposite to that on which he had actually observed it. This gave occasion to BOSCOVICH, some years afterwards, to examine the different cases of the problem,

and

and to remark that, in one of them, it became indeterminate; and that, by a curious coincidence, this happened in the only case which could be supposed applicable to the astronomical problem above mentioned; in other words, he found, that in the state of the data, which must there always take place, innumerable lines might be drawn, that would be all cut in the same ratio, by the four lines given in position. This he demonstrated in a dissertation published at Rome in 1749, and since that time in the third volume of his *Opuscula*. A demonstration of it, by the same author, is also inserted at the end of CASTILLON's Commentary on the *Arithmetica Universalis*, where it is deduced from a construction of the general problem, given by MR THOMAS SIMPSON, at the end of his Elements of Geometry*. The proposition, in BOSCOVICH's words, is this: "Problema quo quæritur recta linea quæ quatuor rectas positione datas ita fecet, ut tria ejus segmenta sint invicem in ratione data, evadit aliquando indeterminatum, ita ut per quod-vis punctum cuiusvis ex iis quatuor rectis duci possit recta linea, quæ ei conditioni faciat satis †."

IT is needless, I believe, to remark, that the proposition thus enunciated is a Porism, and that it was discovered by BOSCOVICH, in the same way, in which I have supposed Porisms to have been first discovered by the geometers of antiquity. I shall add here a new analysis of it, conducted according to the method of the preceding examples, and to which the following *lemma* is subservient.

LEMMA

* Elements, p. 243, Edit. 3. SIMPSON's solution is remarkably elegant, but no mention is made in it, of the indeterminate case.

† Jos. BOSCOVICH Opera, Bassani. tom. 3. p. 331.

LEMMA I. FIG. 10.

32. If two straight lines, AE and BF, be cut by three other straight lines, AB, CD and EF, given in position, and not all parallel to one another, into segments having the same given ratio, they will intercept between them segments of the lines given in position, viz. AB, CD, EF, which will also have given ratios to one another *.

P R O P.

* DEMONSTRATION.—Through C and E draw CH and EG, both parallel to AB, and let them meet BG, parallel to AE, in H and in G. Let GF and HD be joined; and because AC is to CE, that is, BH to HG as BD to DF, by hypothesis, DH is parallel to GF, and has also a given ratio to it, viz. the ratio of GB to BH, or of EA to AC. Take GK equal to HD, and join EK, and the triangle EGK will be equal to the triangle CHD, and therefore the angle KEG is given, and likewise the angle KEF; and since the ratio of GK to KF is given, if from K there be drawn KL parallel to EG, meeting EF in L, the ratio of EL to LF will be given. But the ratio of EL to LK is given, because the triangle ELK is given in species; therefore the ratio of FL to LK is given; and the angle FLK being also given, the triangle FKL is given in species, as also the triangle FGE. The angle FGE being therefore given, the triangle KGE is given in species, and EG has therefore given ratios to EK and EF. But EG is equal to AB, and EK to CD, therefore AB, CD and EF have given ratios to one another Q. E. D.

HENCE to find the ratios of AB, CD and EF; in EF take any part EL, and make as AC is to CE, so EL to LF; through L draw LK parallel to EG or AB, meeting EK, drawn through E parallel to CD in K; then if FK be drawn meeting EG in G, the ratios required are the same with the ratios of the lines EG, EK, EF. This is evident from the preceding investigation.

If it be required to find the position of the line AE, drawn through the point A, so as to be cut by CD and EF in a given ratio; draw Ac, any how, cutting DC in c, and produce Ac to e, so that Ac may be to ce in the ratio which AC is to have to CE; let E be drawn parallel to DC, intersecting FE in E, and if AE be joined, it is the line required.

HENCE the converse of the lemma is easily demonstrated, viz. that if AE and BF be two lines that are cut proportionally by the three lines AB, CD, EF; and if AB and EF, the parts of any two of these last, intercepted between AE and BF, be also cut proportionally, any how, in b and f, and if bf be joined, meeting the third line in d, bf will be cut in the same proportion with AE or BF. For if not, let bf' be drawn from b, meeting CD in d', and EF in f', so that $bd':d'f'::AC:CE$; then by the lemma, $ab:AB::Ef:EF$; and by supposition, $ab:AB::Ef:EF$, therefore $Ef'=Ef$, which is impossible. Therefore, &c.

PROP. VI. PORISM. FIG. II.

33. THREE straight lines being given in position, a fourth line, also given in position, may be found, such, that through any point whatever a straight line may be drawn, which will intersect these four lines, and will be divided by them into three segments, having given ratios to one another.

LET AB, CD, EF be the three lines given in position, and OL the line to be found, and $\alpha\delta$ a given line, of which the segments $\alpha\beta$, $\beta\gamma$, $\gamma\delta$ have given ratios to one another.

LET A be a given point in the line AB, and suppose, that AO is drawn from it, intersecting the lines CD, EF and OL in the points C, E and O, and divided at these points into the segments AC, CE, EO, having the same ratios to one another, with the given segments $\alpha\beta$, $\beta\gamma$, $\gamma\delta$ of the line $\alpha\delta$. Then, because the lines CD, EF are given in position, and also the point A, the line AE is given in position and magnitude, (§ 32.) and therefore also EO, which has a given ratio to AE ; the point O is therefore given.

AGAIN, let B be any point whatever in AB, and let BL be drawn, according to the hypothesis of the Porism, so as to be divided in the points D, F and L, where it intersects the lines CD, EF and OL into the parts, BD, DF and FL, having the same ratios with the parts $\alpha\beta$, $\beta\gamma$, $\gamma\delta$.

LET also BG be drawn equal and parallel to AE, and let EG be joined ; EG will therefore be parallel to AB, and will be given in position ; and if GF be drawn, it will make given angles with EG and EF, because, by the preceding lemma, the ratio of AB to EF, that is, of EG to EF is given. Through L draw LN parallel to BG, meeting GF produced in N.

THEN

THEN because the triangles BFG, LFN are similar, GF is to FN as BF to FL, that is, in a given ratio; and therefore, since FG also makes given angles with the two straight lines EG and EF, given in position, the point N is in a straight line, given in position, and passing through E, *viz.* EN.

Now, since BF is to FL as BG to LN, and also as AE or BG to EO, LN and EO are equal, and being also parallel, OL is parallel to EN, that is, to a line given in position; and the point O, in OL, is given, therefore OL is given in position; which was to be found.

Construction. FROM any two given points, A and B', in the line AB, draw AE and B'F intersecting CD and EF in C, E, D' and F', so that AC may be to CE, and B'D' to D'F' in the same given ratio of $\alpha\beta$ to $\beta\gamma$, (§ 32.) Produce also AE to O, and B'F' to L', so that AE may be to EO, and B'F' to FL' in the same given ratio of $\alpha\gamma$ to $\gamma\delta$. If OL' be joined, it will be the line required.

FOR let B be any point whatever in AB, and as AB' to AB, so let OL' be to OL, and let BL be drawn, cutting CD' and EF in D and F, the line BL is divided in these points, similarly to the given line $\alpha\delta$. For since the two lines AO and B'L' are divided similarly by the three lines AB', CD' and OL', and since two of these last, AB' and OL', are also divided similarly to one another by the three lines AO, B'L' and BL, BL will be divided in D, in the same ratio wherein B'L' is divided in D', or AO in C, (Lem. 1. Conv.). In the same way, BL is divided in F, in the same ratio wherein AO is divided in E; BL is therefore similarly divided to AO, or to $\alpha\delta$, which was to be demonstrated.

34. HENCE it is plain, "If two similarly divided lines, as AO and BL, be drawn any how, and if straight lines AB, CD, EF, OL, be drawn through the points of division of these lines, innumerable lines may be placed between the lines AB, CD, EF and OL, which will be divided by them, similarly to the lines AO, and BL." For, by what is here demonstrated, every line which cuts

any two of the lines AB, CD, &c. proportionally, will also cut the others proportionally, and will be cut by them into segments having the same ratio to one another, with the segments of the lines AO and BL.

FROM this it follows, that the astronomical problem, above mentioned, becomes a Porism, and is indeterminate, in the case when the observations of the comet are not very distant from one another. For on this supposition, the arches described by the earth, and by the comet during the time in which the observations are made, will not differ much from two straight lines ; and these lines will be divided similarly to one another, because each of them will be divided into parts, proportional to the intervals of time between the observations. The places of the earth, at the times of the observations, may therefore be nearly represented by the points A, C, E and O, in the straight line AO, and those of the comet by the points B, D, F and L, in the straight line BL, these lines AO and BL being divided both into parts having the same ratios. The position of BL therefore is not given, since, by the Porism, it may be any line whatever, which cuts the two lines, AB and OL, in a certain ratio.

IT is also to be remarked, that in order to render this, or any other geometrical problem, of no use in questions where the data are furnished by observation, and are consequently liable to some inaccuracy, it is not necessary, that the problem should be reduced exactly to the porismatic case ; for even on a near approach to that case, a very small error in the data will produce so great an error in the conclusion, that no dependence can be had upon its accuracy.

THIS will be made evident in the present instance, by considering how the construction of the Porism is subservient to the solution of the other cases of the problem. Suppose that four lines, AB, CD, EF, RS, (fig. 11.) are given in position, and that it is required to draw a straight line that shall be divided by these lines into parts having the ratios of the given lines $\alpha\beta$, $\beta\gamma$, $\gamma\delta$.

Let

Let KT be that line, and assuming the points A and B', and drawing the lines AO, B'L, so that they may be similarly divided to the line $\alpha\delta$, as in the construction of the Porism, then if OL be joined, it will be given in position, and the extremity K, of the line KT, will be in the line OL, by the Porism; but it is also in the line RS; it is therefore given. Now, by the lemma, AT is to TB' as OK to KL', and the lines OK and KL' being given, the ratio of AT to TB' is given, so that T is given, and therefore TK is given in position. Q. E. I.

Now, it is evident, that if RS make a small angle with OL, any error in the determination of that angle will make a great variation in the position of the point K. A small change in it may, for instance, make RS parallel to OL, and consequently will throw off K, to an infinite distance, so that the line, which is sought, will be impossible to be found; and in general, the variation of the position of K, corresponding to a given variation in the angle RKO, will be, *cæteris paribus*, inversely as the square of the sine of that angle. The nearer, therefore, that the problem is to the Porism, the less is the solution of it to be depended on, and the more does it partake of the indefinite character of the latter.

35. Sir ISAAC NEWTON has extended the hypothesis of the problem from which the preceding Porism is derived, and has formed from it one more general, which he has also resolved, with a view to its application in astronomy. It is this: "To describe a quadrilateral, given in species, that shall have its angles upon four straight lines given in position *."

As it is evident, that the former problem is but a particular case of this last, it is natural to expect, that a Porism is also to be derived from it, or that the lines given in position may be such, that the problem will become indeterminate. On attempting the analysis, I have accordingly found this conjecture verified;

* Prin. Math. lib. 1. lem. 27.

fied ; the investigation depending on a *lemma* similar to that which is prefixed to the preceding proposition.

L E M M A II. FIG. 12.

IF two triangles ABC, DEF, similar to a given triangle, be placed with their angles on three straight lines given in position, so that the equal angles in both the triangles may be upon the same straight lines, the ratios of the segments of these straight lines, intercepted between the two triangles, that is, of AD, BE and CF, are given *.

P R O P.

* DEMONSTRATION.—Complete the parallelogram under AC and AD, *viz.* AG, and on DG describe the triangle DGH, similar and equal to the triangle ABC. Join FG, BH and HE. Through G also, draw GK, equal and parallel to HE, and join CK; CK will be equal and parallel to BE, and the triangle CGK equal to the triangle BHE. The angle GCK is therefore given, being equal to the given angle HBE ; and the angle GCF being given, the angle FCK is also given.

THE triangles DHE, DGF are similar ; for the angles FDE, GDH being equal, the angles FDG, EDH are likewise equal ; and also, by supposition, FD being to DE as GD to DH, FD is to DG as DE to DH. The angle FGD is therefore equal to the angle EHD, and FG is also to EH, or to KG, as FD to DE, or as GD to DH.

BUT if GL be drawn parallel to HD, the angle KGL will be equal to the angle EHD, that is, to the angle FGD, and therefore the angle KGF to the angle LGD or GDH ; and it has been shewn, that FG is to GK as GD to DH ; therefore the triangle FGK is similar to the triangle GDH, and is given in species.

DRAW GM perpendicular to CF, and GN making the angle MGN equal to the angle FGK or GDH, and let GM be to GN in the given ratio of FG to GK, or of GD to DH. Join CN and NK. Then, because MG:GN::FG:GK, MG:FG::GN:GK ; and the angle MGF being equal NGK, the triangles MGF, NGK are similar, and therefore GNK is a right angle. But since the ratio of MG to GN is given, and also of MG to GC, the triangle CGM being given in species, the ratio of GC to GN is given, and CGN being also a given angle, because each of the angles CGM, MGN is given, the triangle CGN is given in species, and consequently the ratio of CG to CN is given. The angle NCK is therefore given ; and the angle CNK is likewise given, each of the angles CNG, GNK being given, therefore the triangle CNK is also given in species. The ratio of CN to CK is therefore given, and since the ratio of CN to CG is also given, the ratio of CG to CK

is

PROP. VII. P O R I S M. FIG. 13.

36. THREE straight lines being given in position, a fourth may be found, which will also be given in position, and will be such, that innumerable quadrilaterals, similar to the same given quadrilateral, may be described, having their angles placed, in the same order, on the four straight lines given in position.

LET AD, BE, CF be the three straight lines given in position, and $ablc$ a given quadrilateral. Let A be a given point in the line AD, and let ABLC be a quadrilateral, similar to the given quadrilateral $ablc$, placed, so that the angles of the triangle ABC, similar to the given triangle abc , may be, one of them, at the given point A, and the other two, on the lines BE and CF. The points B and C, and the triangle ABC, will therefore be given, (Lemma 2. Cor.) and consequently the triangle CBL will also be given in position and magnitude, and the point L will be given. The line to be found must pass through L; let it be LM; let M be any point in it whatsoever, and let MEDF be a quadrilateral similar to the given quadrilateral $ablc$, having its angles on the four lines LM, CF, BE and AD, the angle at M being equal to the angle CLB, &c.

COMPLETE the parallelogram AG, under CA, AD, and on DG describe the quadrilateral GDHN, similar and equal to the quadrilateral

is given, and the triangle CGK given in species. The angle KGC is therefore given, and the angle KGF being also given, the angle CGF is given, and consequently the ratio of CG to CF. The ratios of the lines CG, CK and CF to one another, that is, of AD, BE and CF to one another, are therefore given. Q. E. D.

Cor. HENCE also it appears, how a triangle given in species may be described, having its angles on three straight lines given in position, and one of the angles at a given point in one of the lines. The solution of this problem is therefore taken for granted, in the analysis of the Porism, though, for the sake of brevity, the construction is omitted.

drilateral ABLC; join BH and LN, and it is evident, that the three lines CG, BH and LN are all equal, and parallel to AD, and are all given in position. Join also AL, DN, DM, MN and FG.

BECAUSE the two quadrilaterals DEMF, DHNG are similar, the angle FDM is equal to the angle GDN, and therefore the angle GDF to the angle NDM. For the same reason also, $GD : DF :: ND : DM$, and therefore the triangles GDF, NDM are similar, and the angle FGD equal to the angle MND, and $FG : MN :: GD : DN$, so that FG has a given ratio to MN.

BUT because the triangles ABC, DEF are similar, CG has a given ratio to CF, (Lem. 2.) so that the angle GCF being given, the triangle CGF is given in species, and FG has to GC a given ratio; now, FG was also shewn to have to MN a given ratio; therefore MN has a given ratio to CG, that is, to LN.

AGAIN, since the triangle CGF is given in species, the angle CGF is given, and CGD being also a given angle, the angle FGD is given, and therefore MND, which is equal to it. But the angle LND is given, therefore the angle LNM is given; and it was shewn, that MN has a given ratio to NL, therefore the angle MLN is given; now, the point L, and the line LN, are given in position; therefore LM is also given in position, which was to be found.

THE construction for finding LM is obvious. Take A and D, two given points in one of the lines given in position, and place the two triangles ABC, DEF similar to the given triangle abc, so that two of their equal angles may be at A and D, and the other equal angles on the lines BE and CF, (Lem. 2. Cor.). On BC and EF, describe the triangles BLC, FEM, similar to the triangle cbl; if LM be drawn, it will be the line required.

FROM the analysis it also follows, that the quadrilaterals described with their angles on the four straight lines given in position, as supposed in the Porism, will intercept between them segments of these lines, having given ratios to one another.

37. THIS Porism may also be extended to figures of any number of sides, and may be enunciated more generally thus: "A rectilineal figure of any number of sides, as m , being given, and three straight lines being also given in position, $m-3$ straight lines may be found given in position, so that innumerable rectilineal figures may be described, similar to the given rectilineal figure, and having their angles on the straight lines given in position."

HENCE also this theorem: "If any two rectilineal figures be described similar to one another, and if straight lines be drawn, joining the equal angles of the two figures, innumerable rectilineal figures may be described, which will have their angles on these lines, and will be similar to the given rectilineal figures; and the segments of the lines given in position, intercepted between any two of these figures, will have constantly the same ratio to one another."

As a *Locus*, the same proposition admits of a very simple enunciation, and has a remarkable affinity to that with which EUCLID appears to have introduced his first book of Porisms. "If three of the angles of a rectilineal figure, given in species, be upon three straight lines given in position, the remaining angles of the figure will also be on straight lines, given in position."

If the rectilineal figures here referred to be such, as may be inscribed in a circle, or in similar curves of any kind, agreeably to the hypothesis of the problem *, by which these last Porisms were suggested, we shall have a number of other Porisms respecting straight lines given in position, which cut off, from innumerable such curves, segments that are given in species. A great field of geometrical investigation is, therefore, opened by the two preceding propositions, which, however, we must at present be content to have pointed out.

38. A QUESTION nearly connected with the origin of Porisms still remains to be resolved, namely, from what cause

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* *Prin. Math. lib. 1. prop. 29.*

has it arisen, that propositions which are in themselves so important, and that actually occupied so considerable a place in the ancient geometry, have been so little remarked in the modern? It cannot indeed be said, that propositions of this kind were wholly unknown to the moderns before the restoration of what EUCLID had written concerning them; for beside M. BOCCOVICH's proposition, of which so much has been already said, the theorem which asserts, that in every system of points there is a centre of gravity, has been shewn above to be a Porism; and we shall see hereafter, that many of the theorems in the higher geometry belong to the same class of propositions. We may add, that some of the elementary propositions of geometry want only the proper form of enunciation to be perfect Porisms. It is not therefore strictly true, that none of the propositions called Porisms have been known to the moderns; but it is certain, that they have not met, from them, with the attention they met with, from the ancients, and that they have not been distinguished as a separate class of propositions. The cause of this difference is undoubtedly to be sought for in a comparison of the methods employed for the solution of geometrical problems in ancient, and in modern times.

IN the solution of such problems, the geometers of antiquity proceeded with the utmost caution, and were careful to remark every particular case, that is to say, every change in the construction, which any change in the state of the data could produce. The different conditions from which the solutions were derived, were supposed to vary one by one, while the others remained the same; and all their possible combinations being thus enumerated, a separate solution was given, wherever any considerable change was observed to have taken place.

This was so much the case, that the *sectio rationis*, a geometrical problem of no great difficulty, and one of which the solution would be dispatched, according to the methods of the modern geometry, in a single page, was made, by APOLLO-

NIUS, the subject of a treatise consisting of two books. The first book has seven general divisions, and twenty-four cases; the second, fourteen general divisions, and seventy-three cases, each of which cases is separately considered. Nothing, it is evident, that was any way connected with the problem, could escape a geometer, who proceeded with such minuteness of investigation.

THE same scrupulous exactness may be remarked in all the other mathematical researches of the ancients; and the reason doubtless is, that the geometers of those ages, however expert they were in the use of their analysis, had not sufficient experience in its powers, to trust to the more general applications of it. That principle which we call the *law of continuity*, and which connects the whole system of mathematical truths by a chain of insensible gradations, was scarcely known to them, and has been unfolded to us, only by a more extensive knowledge of the mathematical sciences, and by that most perfect mode of expressing the relations of quantity, which forms the language of algebra; and it is this principle alone which has taught us, that though in the solution of a problem, it may be impossible to conduct the investigation without assuming the data in a *particular* state, yet the result may be perfectly *general*, and will accommodate itself to every case with such wonderful versatility, as is scarcely credible to the most experienced mathematician, and such as often forces him to stop, in the midst of his calculus, and to look back, with a mixture of diffidence and admiration, on the unforeseen harmony of his conclusions. All this was unknown to the ancients; and therefore they had no resource, but to apply their analysis separately to each particular case, with that extreme caution which has just been described; and in doing so, they were likely to remark many peculiarities, which more extensive views, and more expeditious methods of investigation, might perhaps have induced them to overlook.

39. To rest satisfied, indeed, with too general results, and not to descend sufficiently into particular details, may be considered

as a vice that naturally arises out of the excellence of the modern analysis. The effect which this has had, in concealing from us the class of propositions we are now considering, cannot be better illustrated than by the example of the Porism discovered by BOSSOVICH, in the manner related above. Though the problem from which that Porism is derived, was resolved by several mathematicians of the first eminence, among whom also was Sir ISAAC NEWTON, yet the Porism which, as it happens, is the most important case of it, was not observed by any of them. This is the more remarkable, that Sir ISAAC NEWTON takes notice of the two most simple cases, in which the problem obviously admits of innumerable solutions, *viz.* when the lines given in position are either all parallel, or all meeting in a point, and these two hypotheses he therefore expressly excepts. Yet he did not remark, that there are other circumstances which may render the solution of the problem indeterminate, as well as these; so that the porismatic case considered above, escaped his observation: And if it escaped the observation of one who was accustomed to penetrate so far into matters infinitely more obscure, it was because he satisfied himself with a general construction, without pursuing it into its particular cases. Had the solution been conducted after the manner of EUCLID or APOLLONIUS, the Porism in question must infallibly have been discovered.

BUT I have already extended this paper to too great a length; so that, leaving the use of algebra in the investigation of Porisms, to be treated of on another occasion, I shall conclude with a remark from PAPPUS, the truth of which, I would willingly flatter myself, that the foregoing observations have had some tendency to evince: "Habent autem Porismata subtilem
" et naturalem contemplationem, necessariam et maxime uni-
" versalem, atque iis, qui singula perspicere et investigare valent,
" admodum jucundam."

PLATE I.

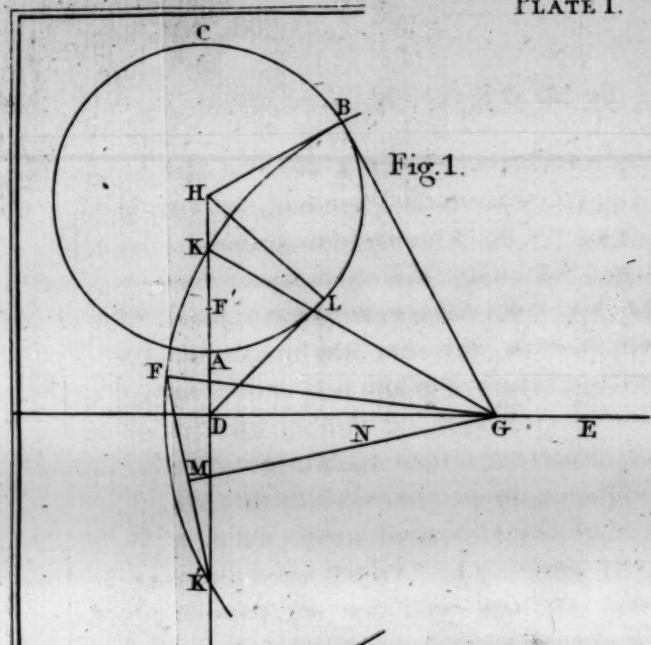


Fig. 1.

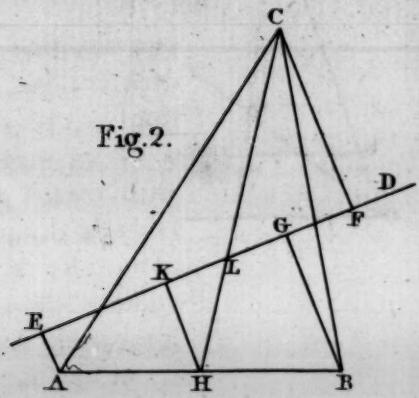


Fig. 2.

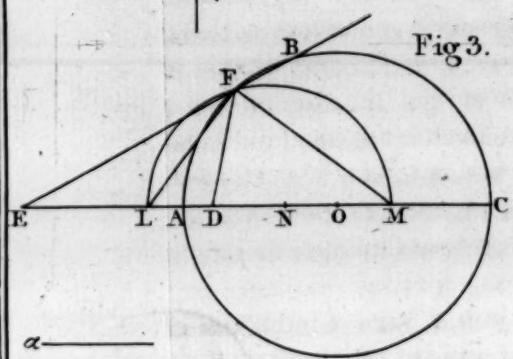


Fig. 3.

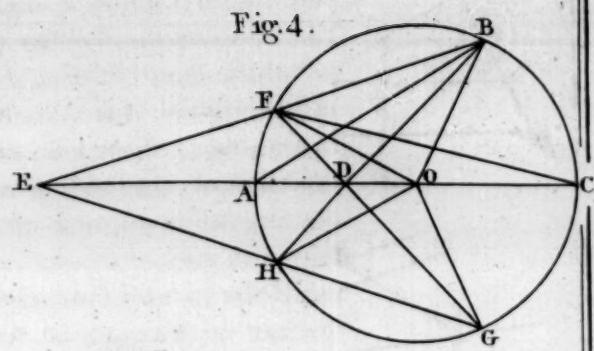


Fig. 4.

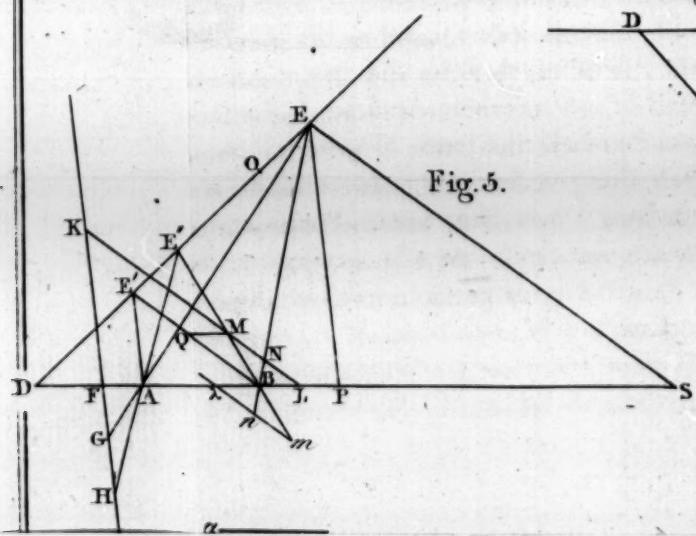


Fig. 5.

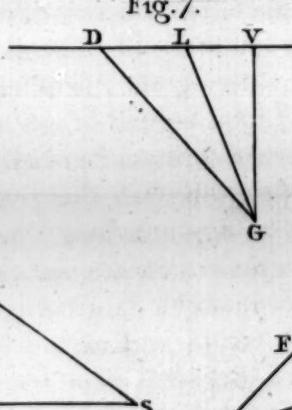


Fig. 7.

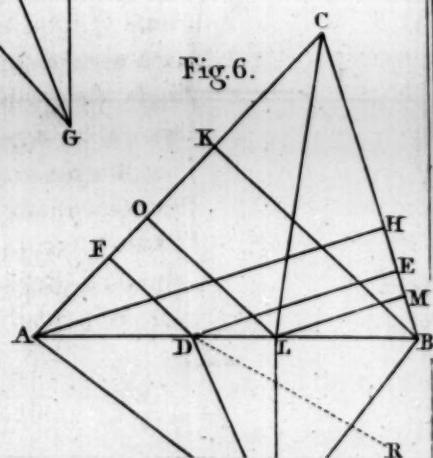
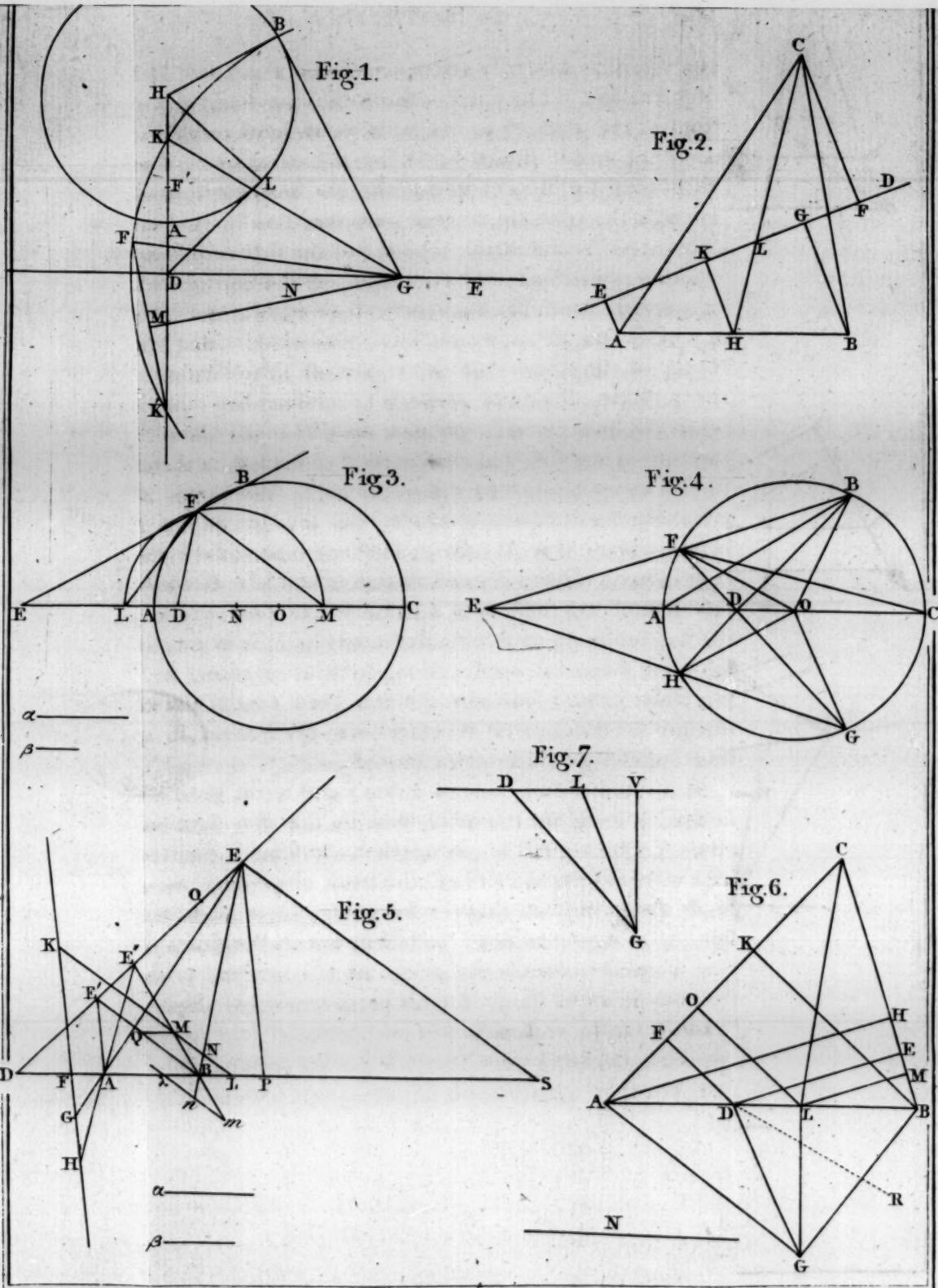


Fig. 6.



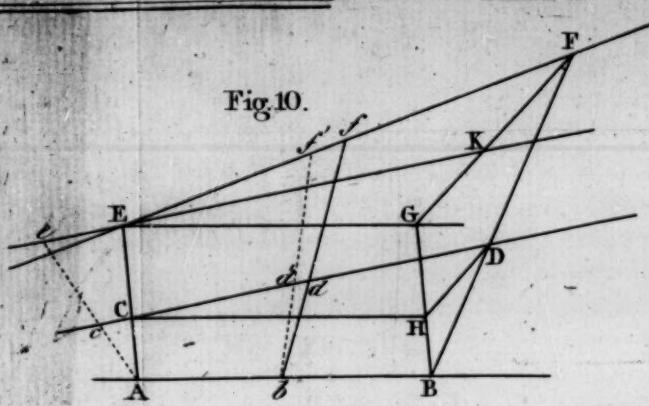


Fig. 10.

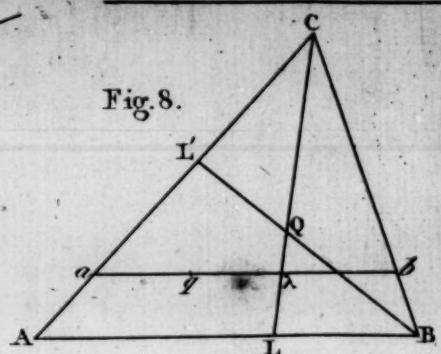


Fig. 8.

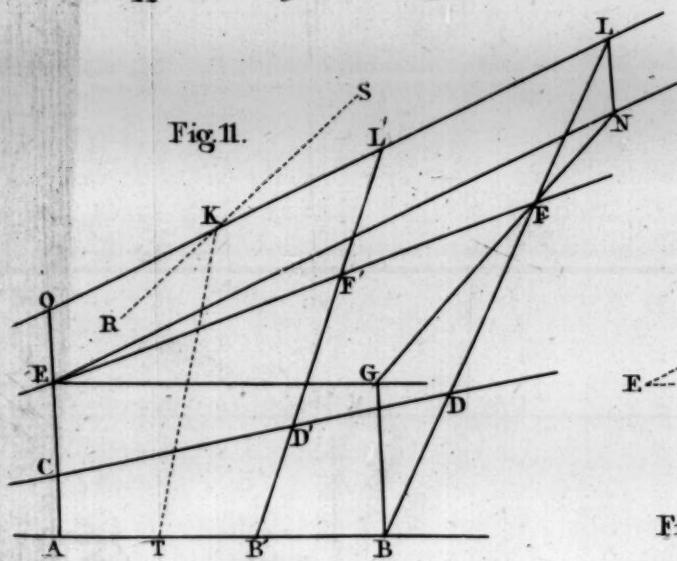


Fig. 11.

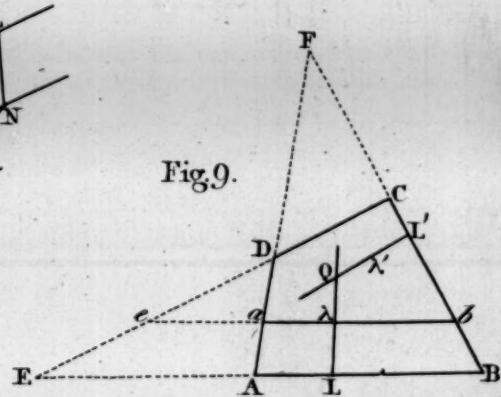


Fig. 9.

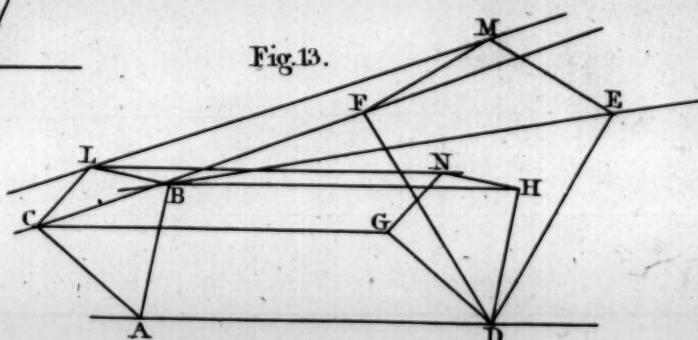


Fig. 13.

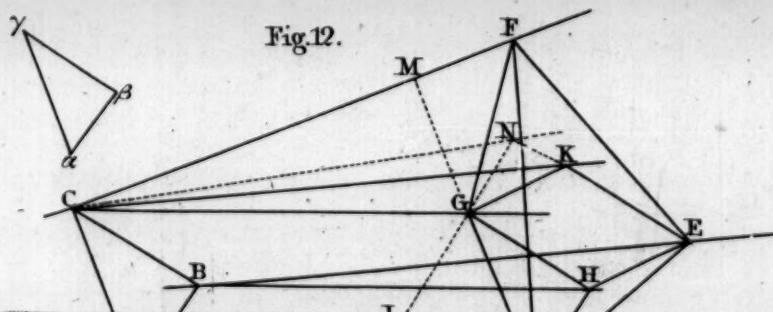


Fig. 12.

Fig. 10.

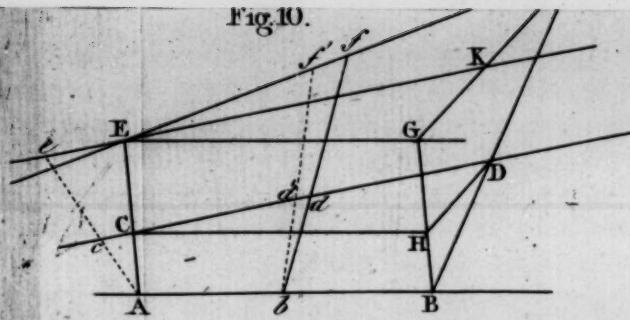


Fig. 8.

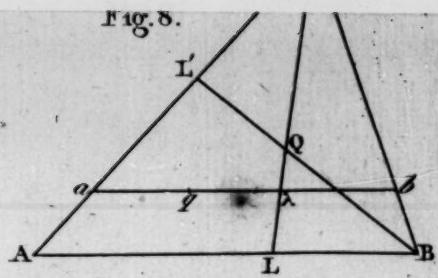


Fig. 11.

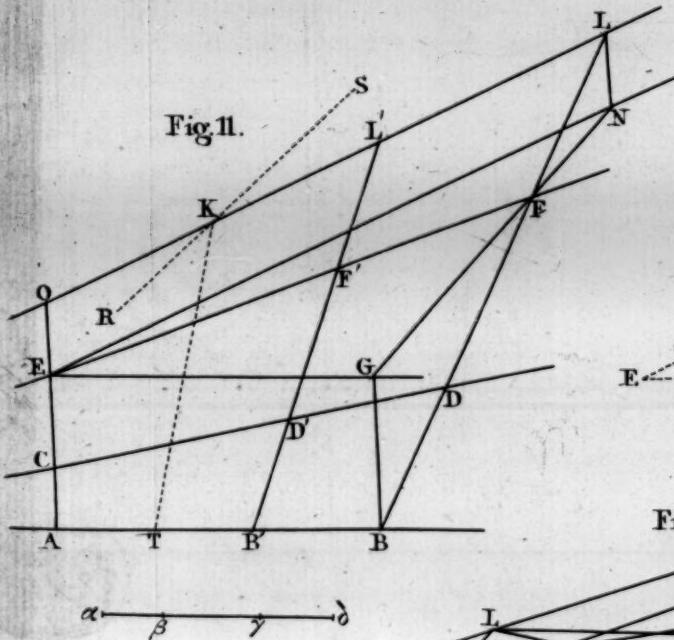


Fig. 9.

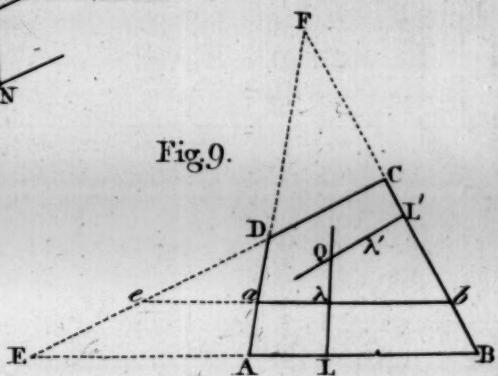


Fig. 13.

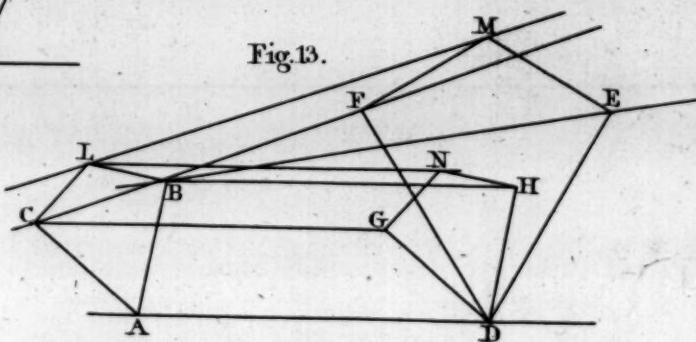
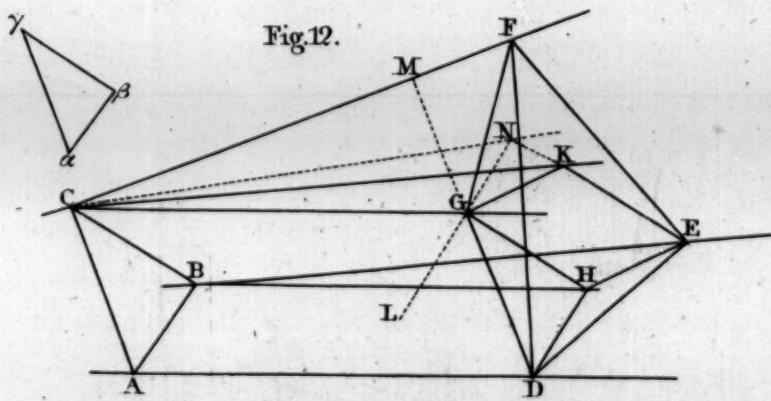
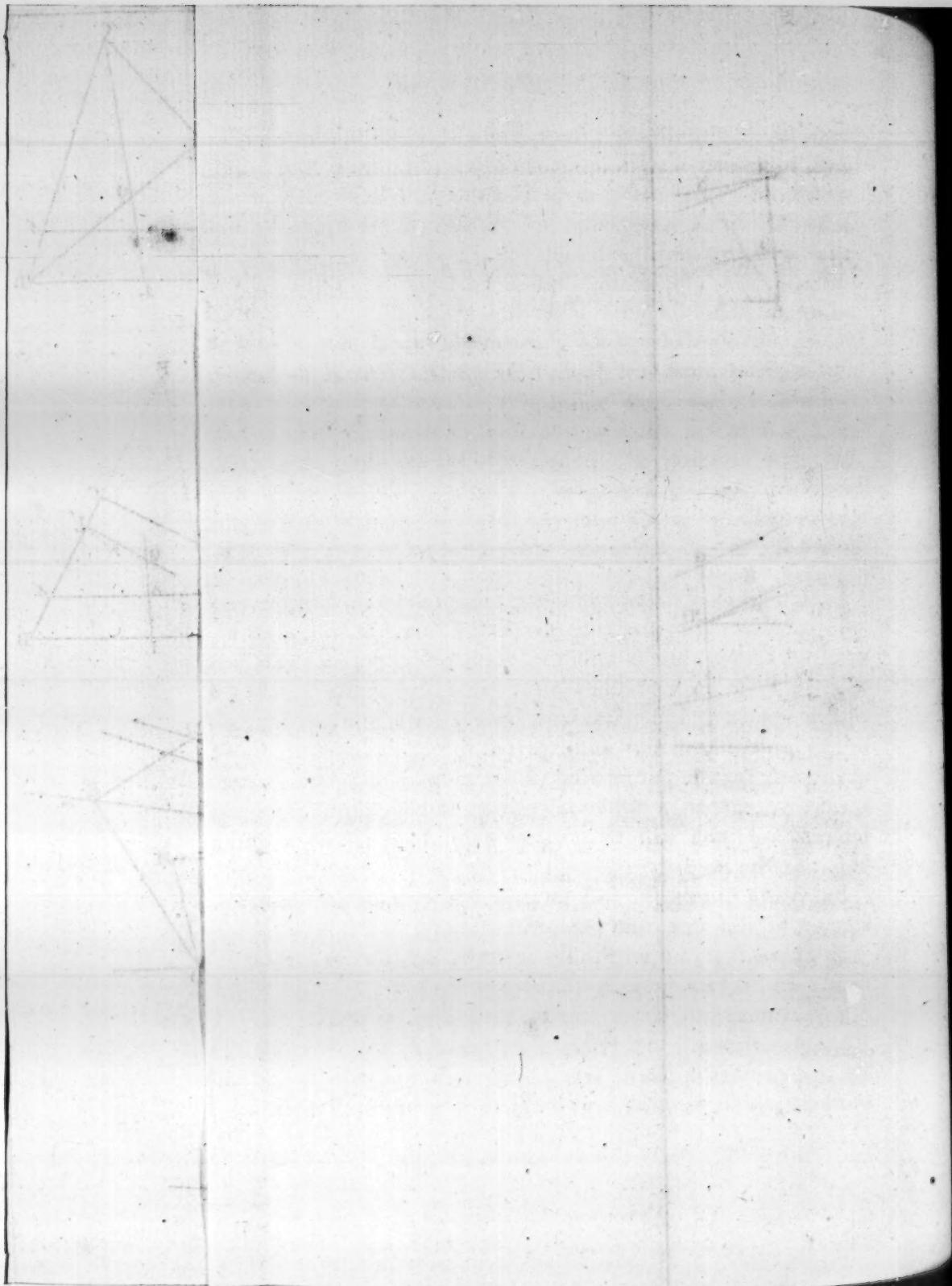


Fig. 12.





VIII. An ACCOUNT of the *QUASSIA POLYGAMA*, or
BITTER-WOOD of Jamaica; and of the *CINCHONA
BRACHYCARPA*, a new Species of JESUIT'S BARK
found in the same Island. By Mr JOHN LINDSAY, Surgeon
in Westmoreland, Jamaica.

[Read Nov. 7. 1791.]

THE *Quassia Polygama* has long been known in Jamaica, and in some other islands in the West Indies, not only as an excellent timber, but as an useful medicine in putrid fevers and fluxes. With us, it is called *Bitter-wood*, and in the Windward Islands, the *Bitter Ash*. The bark has for some time been prescribed by practitioners here, and exported to England in considerable quantities, for the purposes of the brewers of ale and porter. On these accounts, a fuller description of this plant than has hitherto appeared, will be acceptable to the botanist and the public at large.

PREVIOUS to this, it will be proper to give a short historical account of this tree from preceding writers.

Sir HANS SLOANE, who called at Barbadoes, notices the *Bitter-wood*. In his catalogue, he describes it thus: " *Milanomma et melanoxylum, arbor laurifolia nucifera, gemmis nigricantibus, Americana.*" He refers to PLUKENET, Tab. 205. fig. 3.; but that plant is different from ours, and probably he meant another, which we shall have occasion to mention presently.

Dr

Dr PATRICK BROWNE, and after him Mr LONG, in their Histories of Jamaica, mention this tree by the names of *Xylopicrum*, *Xylopia glabra*, *Bitter-wood* or *Bitter Ash*. Mr LONG, in speaking of the *Quassia Amara*, thinks the Bitter Ash of St Christopher's is the same, but does not seem to know whether the Bitter Ash has been found in Jamaica.

Dr WILLIAM WRIGHT, F. R. S. of London, Edinburgh, &c. in his Account of the Medicinal Plants growing in Jamaica *, mentions this tree under the title of *Picrania Amara*, a new genus belonging to the class *Pentandria Monogynia*, and says it is used in putrid fevers as an antiseptic, and that less of it will do, than of the *Quassia Amara* of Surinam. Dr WRIGHT was naturally led to place this tree in the class and order he has done, from finding hermaphrodite flowers and seeds on the same tree; at the same time he remarks, that this tree has a great affinity to the genus *Quassia*.

Dr OLAAF SWARTZ examined most of the plants in Jamaica and the other islands. He probably had seen the same tree in flower and fruit, and in his *Prodromus*, he styles it, “*Quassia Excelsa*, floribus hermaphroditis 5dris paniculatis, foliis impari-pinnatis, foliolis oppositis petiolatis, petiolo nudo.”

No other particular description of this tree has yet appeared; and as both bark and wood may be in more general use, I have taken some pains to examine this new species, and I hope the following account of it will enable the botanist, or any other, to find it. I have, however, given a drawing of the leaves and fructification, which will put every thing out of doubt.

The *Quassia Polygama* is a very common tree in most of our woodlands. It is beautiful, tall and stately. I have measured one, which was 100 feet in length, and ten feet in circumference,

* London Medical Journal, part III. for 1787.

rence, eight feet above the ground. The trunk is straight, smooth and tapering, sending off its branches towards the top.

THE outside bark is pretty smooth, of a light gray or ash colour, from various lichens. The bark of the roots is of a yellow cast, somewhat like the *Cortex Simaruba*. The inner bark is tough, and composed of fine flaky fibres.

THE wood is of a yellow colour, tough, but not very hard. It takes a good polish, and is used as flooring.

THE leaves are sub-alternate; the small leaves are in pairs, from five to eight, standing opposite to each other on short foot-stalks, and ending with an odd one. They are of an oblong oval shape, and pointed; the ribs reddish, and the young leaves are covered with a fine brownish down. The flowers come out in bunches or clusters from the lower part of the last shoot before the leaves, and stand on round foot-stalks. The flowers are small, of a yellowish green colour, with a very small calyx. The male or barren tree has flowers nearly similar to the hermaphrodite, but in it there are only the rudiments of a style.

THE fruit is a smooth black *drupa*, round shaped, and of the size of a pea. There is but little pulp, and the nut covers a round kernel. These *drupæ* are generally three, sometimes two, and often only one, attached sideways to a roundish fleshy receptacle. It flowers in October and November, and its fruit is ripe in December and January.

EXCEPT the pulp of the fruit, every other part of this tree has an intensely bitter taste. From this quality, Sir JOSEPH BANKS, Dr SOLANDER, and Dr WRIGHT in the paper above mentioned, gave it the name of *Picrania Amara*. In taste and virtues, it is nearly equal to the *Quassia* of Surinam, and I am credibly informed, is sold in London for the *Quassia Amara*, and it may be safely used in all cases where that drug has been thought proper, whether as an antiseptic, or in cases of weakness

ness

ness in the stomach and bowels. It may either be given alone, or joined with the Jesuit's bark.

I HAVE seen the happiest effects from the use of this medicine in obstinate remitting fevers from marsh miasmata, in agues which had resisted the use of Jesuit's bark, and in dysenteries of long standing. It is in daily practice in dropsies from debility, either in simple infusions or tincture by itself, or joined with aromatics and chalybeates.

Dr DRUMMOND, an eminent Physician here, prescribes it with great success in the above cases, as well as in amenorrhæa, chlorosis, dyspepsia, and in that species of pica called *Dirt-eating*, so fatal to a number of negroes.

THE bark of the Quassia Polygama, but especially the wood, is intensely bitter. I have used both in various forms.

THE bark is difficult to be reduced to powder. The dose is from 15 grains to 1 dram, either by itself, or joined to the Jesuit's bark.

3ii, 3iii, or 3ss of the bark or wood to 1 lb. watery infusion.

THE same quantities to decoction from 1½ lb. water to 1 lb. The dose is a wine-glass full every three, four or six hours, according to circumstances.

IN certain cases of dropsy, aromatics and preparations are joined to it, also in amenorrhæa and chlorosis; and in worm fevers, the cabbage bark, or other vegetable anthelmintics.

Linnaean Description of the Quassia Polygama.

ARBOR excelsa saepe centum pedes alta. *Caudex* spectabilis, erectus, glaber. *Cortex* cinereus in Epidermide, interne albidus flavescens, tenax et ex fibris lenti confectus. *Ramuli* alterni teretes.

Folia sub-alterna. *Foliola* 5—10 jugata impari-pinnata, opposita, oblonga, obtuse-acuminata, glabra, integerrima, venosa, breviter petiolata. *Petiolus communis* subtus nudus. *Stipulae* laterales parvae, lanceolatae, erectae, deciduae.

Inflorescentia cymosa. *Pedunculi* solitarii, teretes, plerumque nudi, in plurimos ramulos divisi.

FLOS MASCULUS.

Cal. *Periantium*, inferum, minimum, ex squamulis quatuor compositum. *Foliolis* ovatis persistentibus.

Cor. *Petala* 4, oblonga, obtusa, aequalia, sessilia, suberecta. *Nectarium* ex squamis 4 ovatis, villosis, basi filamentorum interiori infertis.

Stam. *filamenta* 4, 5, 6, filiformia, suberecta, aequalia, corolla longiora, receptaculo inserta. *Antheræ* simplices erectæ.

FLOS HERMAPHRODITUS in diversa Arbore.

Cal. et **Cor.** ut in mare.

Stam. ut in mare, sed filamenta corollam vix superant.

Pist. Receptaculum carnosum, orbiculatum, elevatum, germine latius. *Germen* subovatum, ex duobus, tribus, raro quatuor compositum, leviter coherentibus. *Styli* crassiusculi, erecti. *Stigmata* 2, 3, 4, simplicia, declinata.

Per. Drupæ 2, 3, 4, globosæ, laterales, distantes, nigerrimæ, nitentes, receptaculo insertæ.

Sem. Solitaria globosa, unilocularia, nauco fragili tecta.

EXPLANATION OF PLATE I.

- FIG. 1. represents a branch of the male tree in flower, rather under the natural size.
2. A male flower complete, and of the natural size.
3. The same magnified.
4. The stamens in their natural situation magnified, and in the receptacle somewhat depressed.
5. A single stamen magnified.
6. A petal magnified.
7. The same of a natural size.
8. A hermaphrodite flower of the natural size.
9. The same magnified.
10. The pistillum magnified with the squamæ of the calyx; the three germina, styli and stigmata, in their natural situation.
11. The three drupæ or ripe fruit, of their natural size and situation.
12. The receptacle of its usual size.
13. One of the drupæ of ditto.
14. A transverse section of the fruit.

An Account of the CINCHONA BRACHYCARPA, a new Species of Jesuit's Bark, growing in Jamaica.

THIS tree was first discovered in November 1784, on the north-east side of the hill that overlooks the works of *Mountain Spring estate*, in the parish of Westmoreland, and afterwards on some of the mountains near the *Moreland estates* in the same parish. As it has hitherto been unknown to naturalists, I purpose to give a botanical account of it, and afterwards its qualities and medical effects. The better to illustrate my meaning, I sent a drawing of this new plant*, with the fructification, to my late excellent friend Dr HOPE, who wrote me he would lay my paper before the Royal Society of Edinburgh. His death happened soon after, and prevented his intentions.

PENTANDRIA MONOGYNIA.

- Cal.* Perianthium monophyllum, superum, campanulatum, parvum, 5 dentatum, perfistens, dentibus acutis, erectis.
- Cor.* Monopetala, infundibuliformis. *Tubus cylindraceus longissimus.* *Laciinis*, angusto oblongis, patente revolutis.
- Stam.* Filamenta 5, interdum sex, filiformia, tubo longiora, in fauce tubi inserta. *Anteræ lineares erectæ.*
- Pist.* Germen ovatum, inferum. Stylus filiformis longitudine staminum. Stigma crassiusculum ovatum simplex.
- Per.* Capsula oblongo-ovata magna, calyce coronata, bipartibilis, dehiscens in duas partes interius dehiscentes, dissepimento parallelo.

D d 2

Semina

* The drawing alluded to cannot now be found. The figure annexed was taken from a dried specimen in the Herbarium of Dr WRIGHT, who saw the plant, in full flower and fruit, in 1785. Vid. Pl. II.

Semina plurima, parva, compressa, marginata.
 Arbor erecta 20 pedes alta, ramis patentibus. Cortex fusco-cinereus, sapore primo dulci, mox amarescente.
 Folia opposita, oblongo ovata, integerrima, glabra, subtus venosa, petiolata. Petioli breves, supra sulcati. *Stipulae* laterales, ovato-lanceolatae, integræ, caulem arcte amplexantes.
Inflorescentia paniculato-corymbosa, terminalis. *Pedunculus* plurimque brachiato-triternatus, teres, nudus. *Corolla* glabra, palide rubra vel carnea, tres circiter polices longa.

I HAVE only met with this tree in three places; in the inland, woody and mountainous parts of Westmoreland and Hanover parishes. It grew on rocky ground, with a brick mould, and affecting a northern aspect. The tallest I ever saw was about thirty feet high, and 7 or 8 inches in diameter. The branches are few and spreading. The leaves stand in pairs; they are smooth and shining; they are very like those of the *Portlandia grandiflora*. The flowers grow in pretty large clusters, on the extremities of the branches; and have nearly the beauty and appearance of the common honeysuckle, but are rather larger.

THE seed-pod is larger than any other of this genus. It is oval, adorned with the calyx, of a firm consistence, somewhat striated, and black-coloured; when ripe, it splits in two, and discharges a number of small, flat, brown seeds, with a membrane nearly round the edges.

THE trunk and branches are of a brownish gray colour, with a few superficial furrows, and cross cracks like the Peruvian bark. The bark of the trunk is pretty thick, and when wounded, exudes a small quantity of a milky juice. The bark, when dried, is of a purplish brown colour on the inside. It is fibrous, and more difficult to pulverise than the Jesuit's bark in use. The powder is of a purplish gray colour, and tastes sweet, then bitter and astringent.

No opportunity ought to be omitted that can in any way make us more acquainted with this valuable genus *Cinchona*, the salutary effects of which give a security and comfort to the lives of those, in warm and unhealthy climates, beyond any other medicine we know of. This species might be used as a substitute to the Peruvian bark; but it is to be regreted, that the tree is scarce and small, and that enough of it cannot be had, at least in these parts *.

I DO NOT pretend to hold up this new bark as superior, or even equal to the Peruvian. I have given it in the slighter cases of intermitting and remitting fevers, with good effect; and in a few instances, it produced a cure, where the patients had taken the common and red bark to no purpose.

To people afflicted with intermittents, I gave of the powder from twelve grains to thirty every hour, or every two hours in the absence of fever. By this means, a stop was put to the fever, and the patients recovered. I have also administered this new bark in dyspepsia, both in powder and infusion. It sat easy on the stomach, promoted appetite, and was easy to take. I had shewn this species of *Cinchona* to my good friend Dr WRIGHT, before he left the island, and gave him a little of the bark. He gave it in powder to a patient, but found it emetic, which could only happen from some peculiarity in the constitution †. In his letter to me, he intimates, that probably the same thing would happen, with every other of this genus, if given before it was completely dried.

Of

* This loss may be compensated by the abundance of the *Cinchona Caribea* seu *Jamaicensis*, described by Dr WRIGHT in the 67th vol. of Phil. Trans. and which, we are assured, has been found to answer all the purposes of the *Cinchona Officinalis*.

† See Dr WRIGHT's Account of the Medicinal Plants growing in Jamaica, London Medical Journal, part iii. for 1787.

Of the RED PERUVIAN BARK.

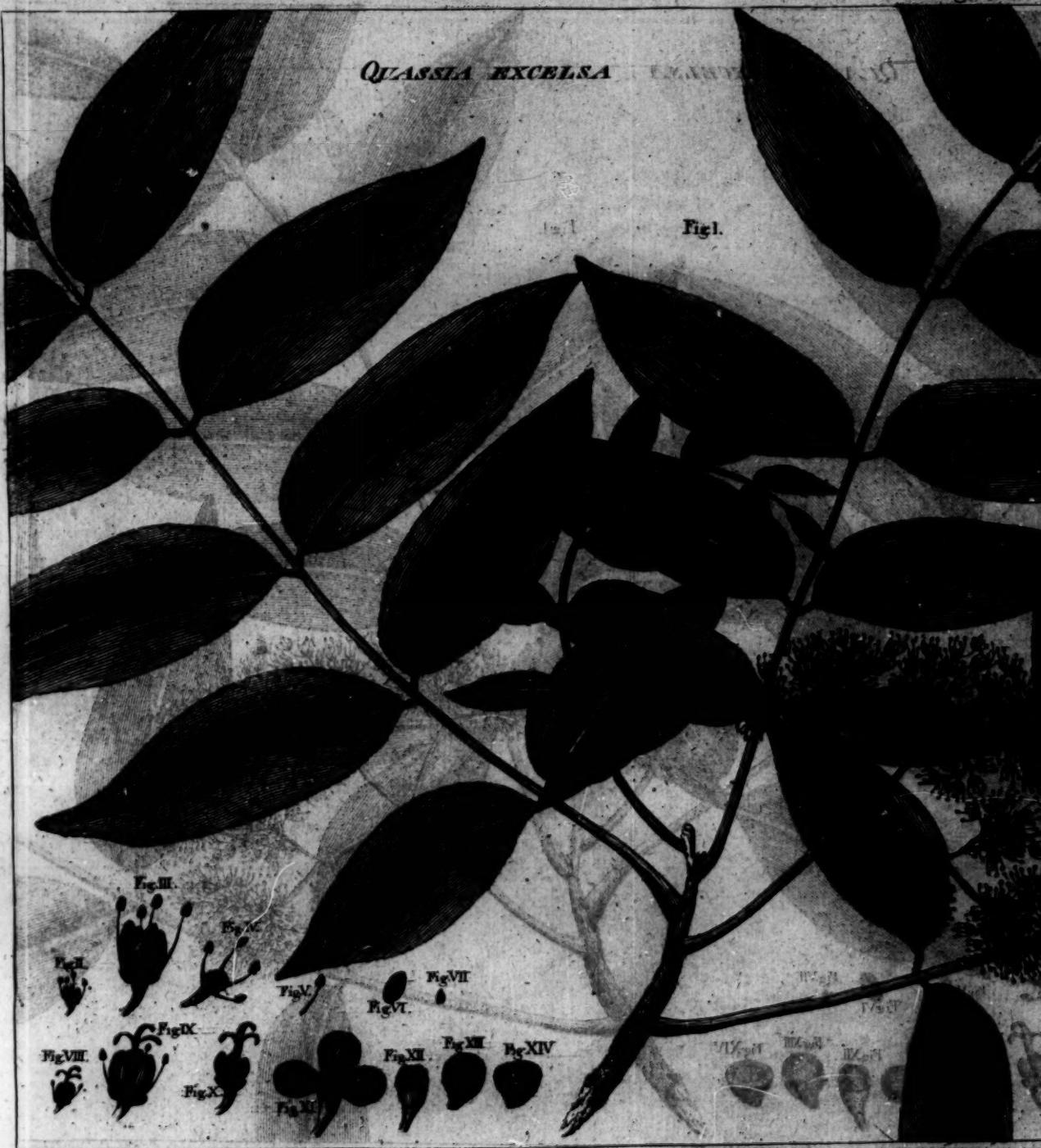
THE red bark, when genuine, and given briskly in pretty large doses, will, in particular cases, occasion a degree of anxiety, depression, giddiness and faintness, that are alarming to the patient and his friends, and perhaps, if not timely attended to, might be of serious consequence. This only happens in certain constitutions, and in weakly habits, or those rendered so by disease.

THIS effect of the red bark, so far as I know, has not been taken notice of by any writer, and when it occurs in private practice, is either not attended to, or imputed to some other cause. The following extract of a letter from JAMES GRAHAM, Esq; a worthy and respectable gentleman of this island, places this circumstance in a strong light.

Mr GRAHAM had been afflicted with a fever and ague for several months, and having consulted an eminent Physician here, had the red bark prescribed him, which he was to take in dozes of thirty grains each. "On taking the first," says he, "I instantly perceived an unusual pungency on my tongue. After the fifth, I felt an anxiety about my breast with faintishness; and had hardly done swallowing the sixth, when I was seized with giddiness, an universal tremor, and a profuse cold sweat. A little wine, which was given me in this situation, relieved me considerably. In about an hour, all the alarming symptoms disappeared, but I remained weak and languid. From that day, however, the fever left me, and did not return till several months after, when it was brought on by a cold, and was removed by the bark administered in the same manner, and attended nearly by the same symptoms as before."

QUASSIA EXCELSA

Fig.

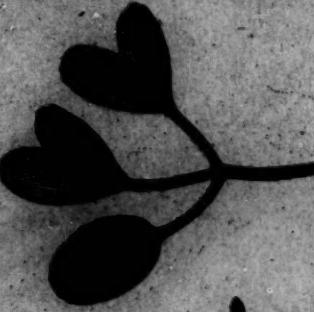


Phytoptilium

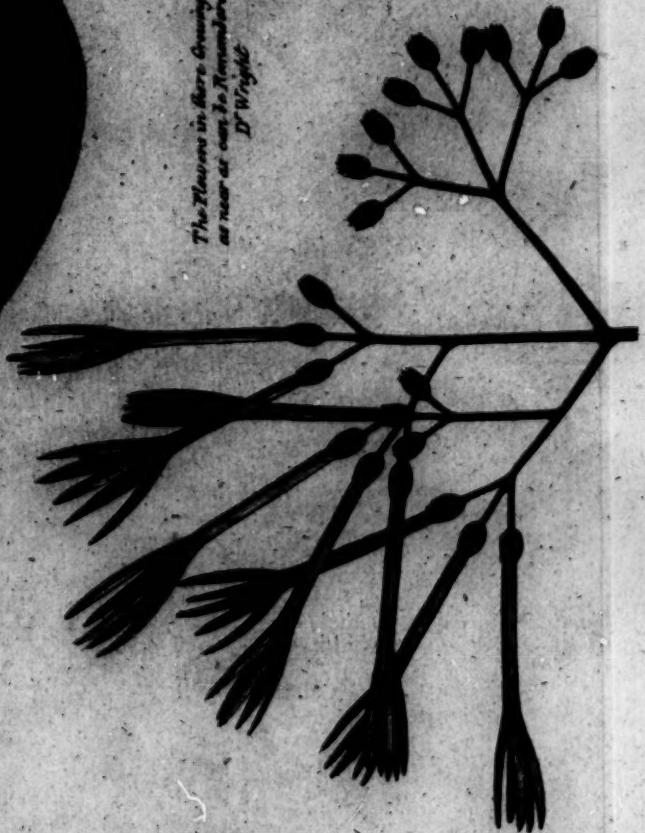


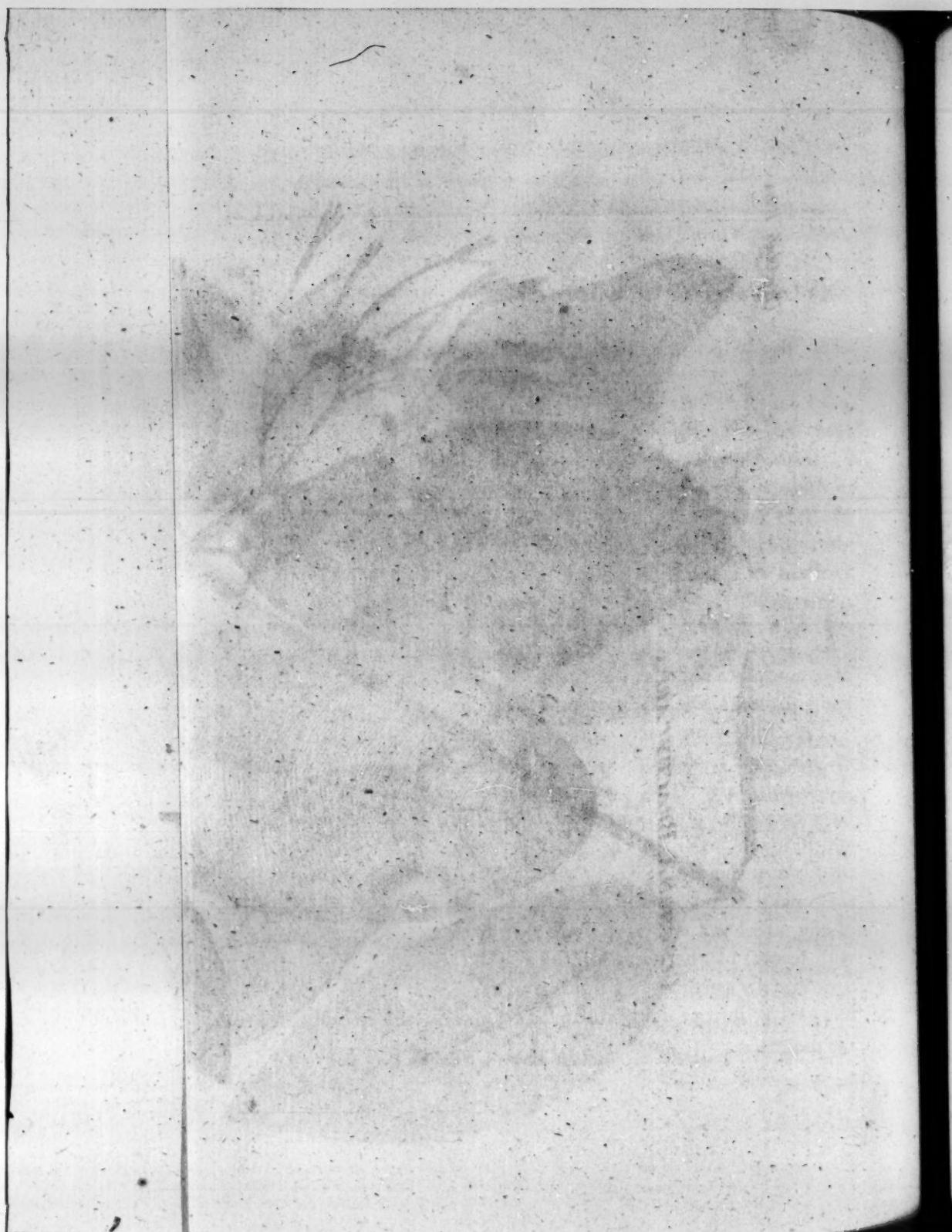


CINCHONA BRACHYCARRA



The Flowers in these drawings
are new or new to Natural History
Dr Wright





**IX. DESCRIPTION of a HUMAN MALE MONSTER, illustrated
by Tables, with Remarks. By ALEXANDER MONRO, M. D.
F. R. S. EDIN. Fellow of the Royal College of Physicians,
Professor of Medicine, Anatomy and Surgery in the University
of Edinburgh, Fellow of the Royal Academy of Surgery in
Paris, &c. &c.**

[*Read Nov. 6. 1792.*]

THIS monster, of which the mother was delivered by Mr THOMAS ANDERSON, surgeon in Leith, after the birth of a complete child at the full time, had its proper membranes and a placenta, with a short umbilical cord.

THE following parts were wanting in it; to wit, the bones of the head; the brain, with the organs of sight, hearing, smell and taste; the neck; about one half of the ribs; the larynx, trachea and lungs; the heart; the pharynx, oesophagus and stomach, with all the small intestines, except the end of the ilium; the anus; the liver, spleen, pancreas and omenta; the renal glands; terminations of the ureters; the middle part of the urethra; the right testicle; both arms; both patellæ; with several of the bones of the feet and toes.

A ROUND opening (see fig. 1. and 2.) which led to a thimble-like cavity, shut at its bottom, had some distant resemblance to the mouth.

THE

THE soft parts of the trunk were supported by sixteen vertebræ, six ribs, an os sacrum, and two ossa innominata. The legs had each an os femoris, tibia and fibula, with an imperfect number of the bones of the feet. See fig. 2. X. and fig. 4. I. &c. to 16. 17.

THE umbilical cord was connected at nearly the usual height above the ossa pubis. See fig. I. E.

THE penis, covered with a large preputium, had the usual situation and structure. See fig. I. F.

THE lower part of the trunk contained an intestinal tube, shut at its beginning, and composed of an upper part, four inches long, resembling the end of the ilium; for it terminated in the side of an intestine, resembling the *caput coli*, with its appendix *vermiformis*. From this place, to its lower end, the great intestine measured thirteen inches; and the end of the rectum, which was much contracted, terminated in the back part of the bladder of urine, above its sphincter. The rectum contained viscid semipellucid mucus, but no black stuff, like the meconium. See fig. 2. O. P. Q. R. S. T. U. V. and fig. 3. O. P.

IN the mesentery and mesocolon, there were about a dozen conglobated lymphatic glands, of the usual shape, colour and consistence. See fig. 2. From which it appeared, that the intestines were provided with lacteal vessels; and we therefore cannot doubt, that the other parts of the body were furnished with lymphatic vessels, or that there was an absorbent, as well as circulating system in this monster.

AT the upper part of the trunk, covered by the ribs, there were two kidneys of a large size, with a pelvis and ureter to each. The right ureter was dilated to the size of a goose's quill. The left one was small. Both were shut at their under ends, and had no communication with a small sac, which, in situation and structure, resembled the bladder of urine, and had

had an urachus coming from it. See fig. 3. W. W. Y. and fig. 2. W. X. Y.

THERE was only one testis, situated in the usual manner, on the left side. See fig. 2. Z.

THE prostate gland surrounded, as usual, the neck of the bladder. See fig. 4. X.

THE urethra, which was the common passage for the faeces, as well as for the seminal liquors, and that of the sac resembling the vesica urinaria, was wanting from within an inch of the vesica to within an inch of the extremity of the penis. See fig. 4. V. Y. and fig. 3. F. G.

THE spinal marrow was of a conical shape, with the top or small part of the cone at its upper end, and at its lower end it formed a cauda equina. From its two ends and sides, it sent off eighteen pairs of nerves; which, at their origin and in their progress, were nearly as large as they are in a perfect foetus, or where the brain and cerebellum are connected with the spinal marrow. See fig. 4. I. &c. to 16. n. n.

THE umbilical cord was nearly proportioned to the bulk of the monster; and, at the umbilicus, consisted of one vein and two arteries, within which I found red blood. The vein was more capacious than both arteries conjoined; and, as soon as it entered the abdomen, was divided into various branches, which were dispersed upon all parts of the body. See fig. 3. a, b, c, d, e, f, g; fig. 2. b, i; fig. 4. b, i.

VESSELS, every where, accompanied the branches of the umbilical vein, corresponding with them in size, as well as situation; and, joining together, formed trunks, from which, at the sides of the pelvis, two vessels were continued, one of them on each side of the vesica urinaria and urachus, to the umbilicus, which they perforated, and then went, along the umbilical cord, towards the placenta, resembling the umbilical arteries. See fig. 3. b, i, k, l, m; fig. 4. k, l; fig. 2. b, i.

UNLUCKILY, before I received the monster from Mr ANDERSON, he had entrusted the injection of its placenta to some person, who had managed it so negligently, that nothing, he told me, could be determined as to the distribution or communication of the vessels of the placenta with each other, or with those of the placenta of the complete child, or with those of the mother.

EXPLANATION of the FIGURES, representing the parts of a human Male Monster, of its real size.

FIG. I. represents the fore view of it entire.

- A. B. C. A circular mass, more than two inches thick, which supplies the place of head, trunk and arms.
- D. A thimble-like cavity, somewhat resembling the mouth.
- E. The umbilical cord.
- F. G. The penis and preputium.
- H. I. K. L. M. N. The thighs, legs and feet.

FIG. II. In this figure, at the letters A. B. C. D. F. G. H. I. K. L. M. N. the same parts are represented as in fig. I. The cavity of the abdomen being laid open by a longitudinal incision, we perceive,

- O. P. The small intestine.
- Q. The caput coli, and appendix vermiformis.
- R. S. T. U. V. The great intestine.
- W. X. The right and left ureters.
- Y. The vesica urinaria and urachus.

Z. The

- Z. The left testicle, with its spermatic cord, cremaster muscle and vas deferens.
b, i. Two large vessels, at the sides of the pelvis, furnished by the umbilical vein.
E. E. The two umbilical arteries.

FIG. II.* In this figure, the conglobated, lymphatic or lacteal glands of the mesentery are represented.

FIG. III. In this figure, the distribution of the blood-vessels, chiefly, is represented. At the letters A. B. C. F. G. H. I. K. L. M. N. the same parts are represented as in fig. 1. and fig. 2.

O. P. shew the intestines pushed behind the blood-vessels to the left side.

W. W. The kidneys and ureters.

X. The ribs which covered the kidney, drawn towards the right side.

Y. The bladder of urine.

a, b, c, d, e, f, g. The umbilical vein, divided into branches for the several parts of the body.

b, i, k, l. Vessels accompanying the several branches of the umbilical vein.

m, Two vessels resembling the umbilical arteries.

n, n, The sciatic nerves.

FIG. IV. In this figure, the spinal marrow, and nerves connected with it, are chiefly represented.

A. B. C. H. I. K. L. M. N. represent the same parts as the former figures..

V. represents a probe passed from the rectum through the neck of the bladder into the urethra.

Y. A bristle passed from the bladder into the urethra.

- S. The spinal marrow.
- E. The cauda equina.
- 1. 2. &c. to 16. Nerves sent off from the spinal marrow in pairs.
- 17. The os sacrum.
- n, n, The sciatic nerves.

REMARKS on such MONSTERS.

MONSTERS wanting the head, heart and lungs, and, in almost every other respect, agreeing with that above described, have been mentioned by authors, particularly by MERY and WINSLOW *, and the learned Dr ROEDERER † has given a full description of a monster, in which one small muscular sac only was found, instead of a complete heart, communicating with the continuation of one of two veins which were found in the umbilical cord ; but the real course of the blood, or the causes of its motion, appear to have been misapprehended by all these authors.

MERY thinks the blood of the foetus must have been moved by the motion of the heart of the mother, and considers the want of the heart in such monsters, as a strong confirmation of the opinion he entertained, that there is a circulation of the blood carried on between the mother and the foetus ‡.

As

* Mem. de l'Acad. 1720 and 1740.

† Act. Got. t. iv. 1754.

‡ MERY, Mem. de l'Acad. des Scien. 1720. 1^{re} Reflexion. " Sa vie n'a pu avoir pour principes que la respiration et le mouvement circulaire du sang de sa mere." And in the Histoire, " Le defaut du cœur prouve que le sang qui a circulé dans ce foetus ne recevoit pas son impulsion que du cœur de mere." M. MERY a toujours soutenu la circulation reciproque entre la mere et le foetus, et telle que le foetus est toujours comme un membre de la mere.

As WINSLOW had not found any red blood in the vessels of the foetus, nor traced within it the branches of the umbilical vein, but those only, as he supposed, of the vessel he called aorta, and which he thought performed the office of an artery, he is led to the supposition, that, instead of a circulation, there was only a sort of progression of the colourless blood, or lymphatic humour, to the capillary extremities of the arterial ramifications, and that it transuded, by little and little, and very slowly, into the cellular texture of all the parts, and perhaps, at last, passed through the pores of the skin, in the form of moisture *.

Dr ROEDERER † not only applies the term of *vena cava* to the large vein with which the umbilical vein is joined to the heart, but describes the cava as ascending from the abdomen to the thorax ‡. In like manner, he not only applies the name

aorta

* WINSLOW, Mem. de l'Acad. des Scien. 1740.

P. 588. " La veine ombilicale, s'étant écartée du cordon de son entrée dans le ventre, yformoit un tronc fort court, qui montoit tout droit et s'implantoit à la base du bouton cutané, s'adossant là avec le tronc d'un autre vaisseau de pareille grosseur, qui sortoit de la même base, et qui étant d'abord courbé vers en bas, descendoit derrière les paquets des intestins, à peu près comme le tronc de la portion inférieure de l'aorte, et se distribuoit ensuite en plusieurs branches, de la maniere que je dirai ci après."

P. 590. " On ne voyoit pas une goutte, ni aucune apparence de sang rouge dans toute l'étendue du corps de cet enfant ; ni aucun vestige de vaisseaux veineux."

P. 600. " Hors la petite portion de la veine umbilicale après son entrée par le nombril, je n'ai trouvé, dans tout le corps de cette enfant, aucun vaisseaux veineux, ni le moindre vestige soit de tronc, soit des ramifications de veines."

P. 604. " Mais à l'égard de la circulation intrinsèque dans les parties mêmes de ce demi-corps, l'absence ou la privation totale des vaisseaux veineux m'a fait conjecturer, qu'au lieu de circulation proprement dite, il n'y a eu qu'une espece de progression ou trufion jusqu'aux extrémités capillaires de toutes les ramifications arterielles, et que là ce sang lymphatique transudoit, peu à peu, et très lentement dans le tissu cellulaire de toutes les parties. — Et, peut-être, pafsoit par les pores externes de la peau, en maniere de moiteur. Je n'avance tout ceci que comme des pures conjectures," &c. &c.

† Com. Soc. R. Sc. Gotting. tom. iv. com. 4.

‡ P. 109. " Duplicem autem umbilicalis funis venam largitur ; altera minor, cum vena cava, ex abdomine ascendentente confluit."

aorta to the vessel which accompanies the continuation of the umbilical veins ; but speaks of his aorta as ascending from the thorax to the head *, and fending off the subclavian and the carotid arteries ; and remarks, that canals proper to the latter were wanting †. And he observes, that the aorta, after descending, as usual, between the crura of the diaphragm, gave off the mesenteric, renal, lumbar and iliac arteries ; and that the left iliac artery sent off an umbilical artery ; and concludes his description in the following words : " Ita, quidem, si arte-
 " riæ umbilicalis dextræ, arteriæque cæliacæ defectus—ex-
 " cipiatur, vix ab usitata fabrica aberrans arteria aorta in abdo-
 " mine distribuitur."

AFTER an elaborate description of the several parts of the monster, Dr ROEDERER proposes the cause of the motion of its humours, in the following words :

P. 189. " MOTUS qui—humores agitat, causa indagatur.
 " Ast aliquis, latus licet, fœtus parasitici humores motus
 " agitavit. A corde, sueto motore, repeti iste motus nequit, ne-
 " que multum auxilii propulsus in uterum maternum sanguis
 " ferre potest. Præter vero istum, levem, debilemque.—
 " Ipsa vasorum actio, sive contrahendo agat, sive attrahendo,

" vi.

* P. 121. " Arteria magna, quam aortam vocant, ex abdomine in thoracem ascendit. In thorace eandem pene directionem servans, nulloque cum corde canali confluens, sola et a cordé distincta, iter suum absolvit. Nullus proinde ex aorta arcus formari potest, sed laterales rami ex recto aortæ trunco emittuntur. Sunt ita rami qui descripti sequuntur.

In regione costæ prime levissime descendentes arteriæ subclavie nascuntur ; ex quibus vicissim triplex alia ramorum species oritur, quarum primus ad cervicem, &c. Porro trunca aorta per semipollicem postquam progressus est in duos ramos dividitur, duas nempe arterias carotides, quæ ad altitudinem laryngis fine insigniori ramo ascendunt. — Ascendit, autem, carotis dextra, &c. — Ad latus tandem laryngis canalis communis in sex omnino ramos dividitur."

† P. 143. " Canalis pro arteria carotide deest. Carotis per amplum foramen lacerum ad cerebrum tendit."

" vi illa capillaribus tubis familiari, præcipuum humoribus
" motum impertiri debet. — Accedant forsan et aliae in foetu
" nostro, causæ incognitæ, ipsa fortasse a colore excitata fluido-
" rum agitatio, aliaque."

BUT as to the direction in which he supposed the humour to be moved, he says nothing, and therefore leaves us to judge of his opinion, from the foregoing description of the blood-vessels.

To the opinions of all these authors, when fully considered, we shall find insuperable objections.

THUS, without saying in objection to that of MERY, that it is so far from being certain, that there is a circulation of red blood between the mother and foetus, that the contrary opinion is the most probable, we cannot conceive, although the anastomoses of the uterine with the placental vessels were proved, that the mere impulse of the blood in the minute arteries should have carried the blood, not only into the trunks, but through all the capillary branches of the vessels of the foetus, and again back from these to the placenta, and from its umbilical arteries into the umbilical veins and veins of the uterus.

THE opinion of WINSLOW is far more unsatisfactory than that of MERY. In the first place, it cannot be applied to the monster described by MERY, or to that before us, where there were two sets of vessels. In the next place, WINSLOW was so far from tracing distinctly the joining of the umbilical vein with the vessel he calls aorta, that he describes it as merely *s'adoffant* with the trunk of the aorta *.

3. ALTHOUGH he repeatedly affirms, that there were no venous vessels in any part of the body of the monster, yet his description of the vessels of the kidney will not, when considered, be found to correspond with his general assertion; for he describes a vessel which indeed he calls arterious, but which began

* See p. 588. of Mem. de l'Acad. or Note, p. 221.

began on the fore-part of the belly above the navel, at the place where the small portion of the umbilical vein terminated in the cavity of the cutaneous button, from which various branches were sent into the kidney at its convex part, and from its concave part, different arteries, he says, came out in an extraordinary manner *.

UPON the whole, as the umbilical cord is not said to have been uncommon in size or structure; as there were two sorts of vessels connected with the kidney; as it is so improbable, as to be incredible, that the foetus received arteries without corresponding veins, or that there was merely a protrusion of the humours, and exudation of them, without circulation, I have no doubt that WINSLOW, especially as he did not inject the vessels of the umbilical cord, had mistaken the continuation of the umbilical veins, and the branches of the vessels he calls aorta, for branches of the same vessel; and as the monster he examined agreed very nearly, in all other respects, with that I have described, I apprehend it must have agreed likewise in having two kinds of blood-vessels or arterious and venous canals.

THE learned Dr ROEDERER rejects the opinion of MERY, that the blood of the foetus is circulated by the heart of the mother, and supposes, that capillary attraction, heat, and some activity of the vessels, may contribute to its motion. But as he applies the term aorta, not to the continuation of the umbilical vein, but to the other principal vessel of the monster, and describes

* P. 602. "Ce tronc arteriel qui étoit comme la portion inférieure de l'aorte descendante, au lieu de tenir la route naturelle en arrière le long des vertebres, il en étoit ici très éloigné. Il commençoit sur le devant du ventre au dessus du nombril, à l'endroit où se terminoit la petite portion de la veine ombilicale.—Il jettoit des branches dans la masse du rein par sa convexité. Il sortoit de la concavité plusieurs artères.



Fig. I.

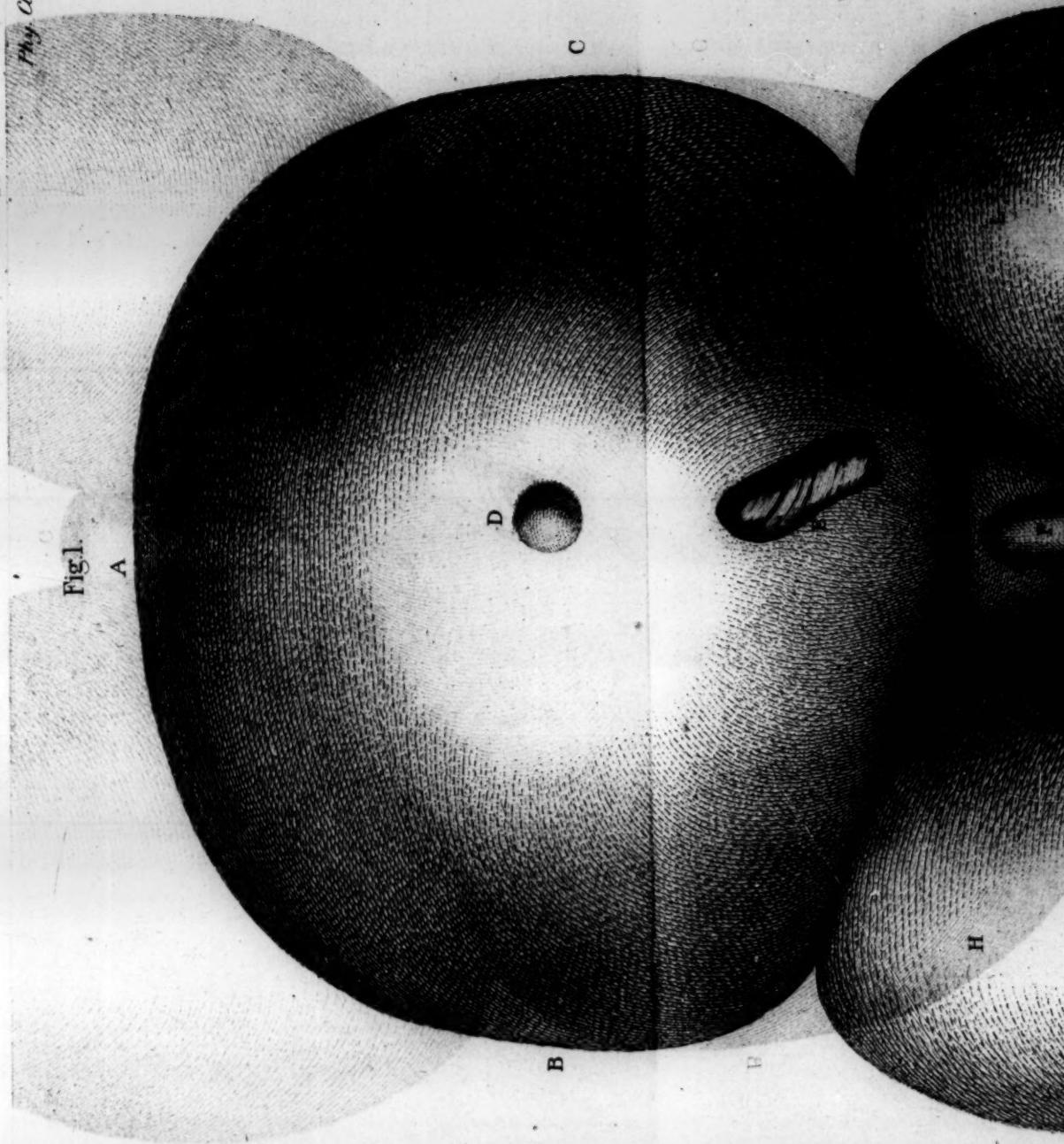
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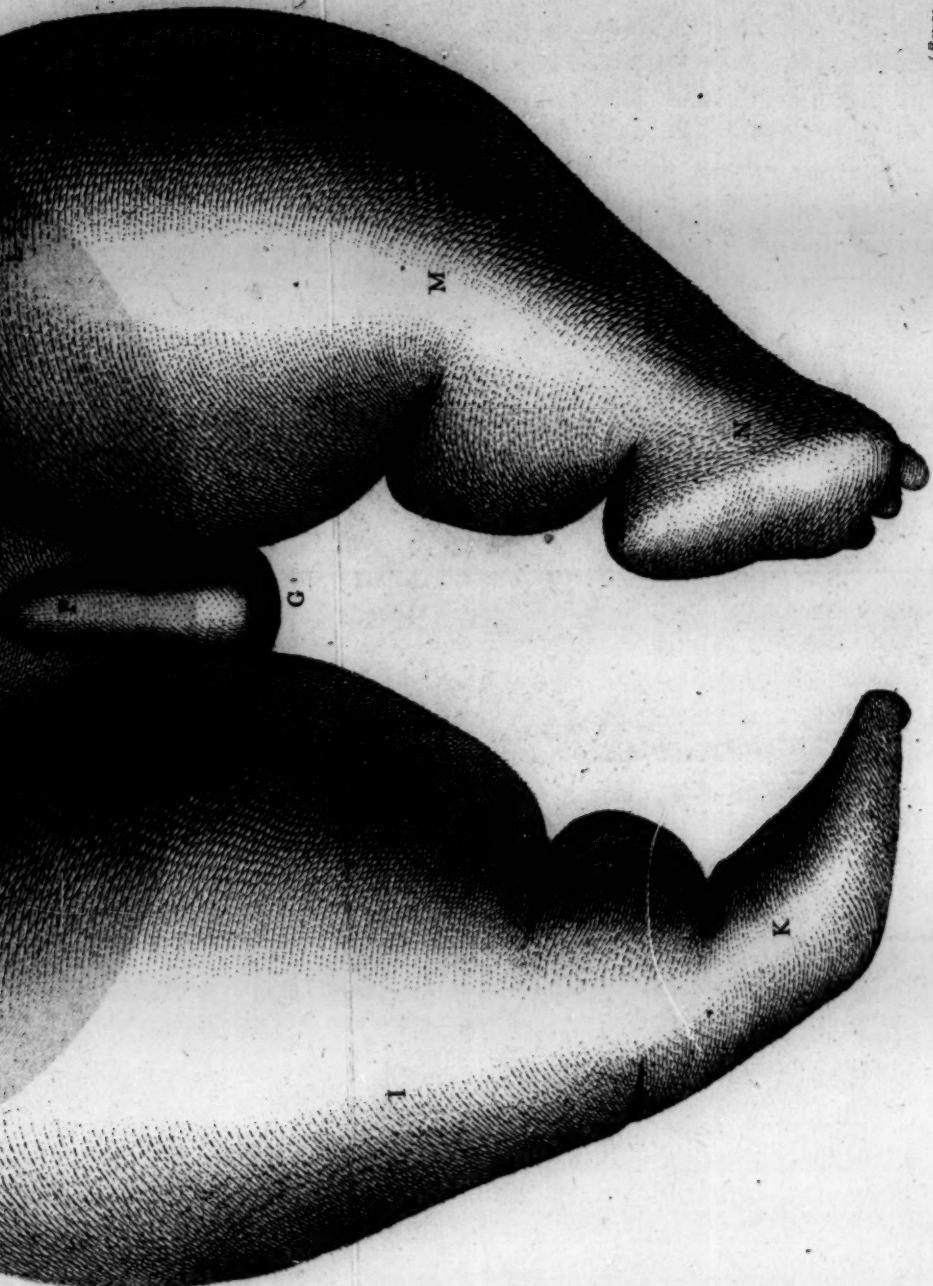
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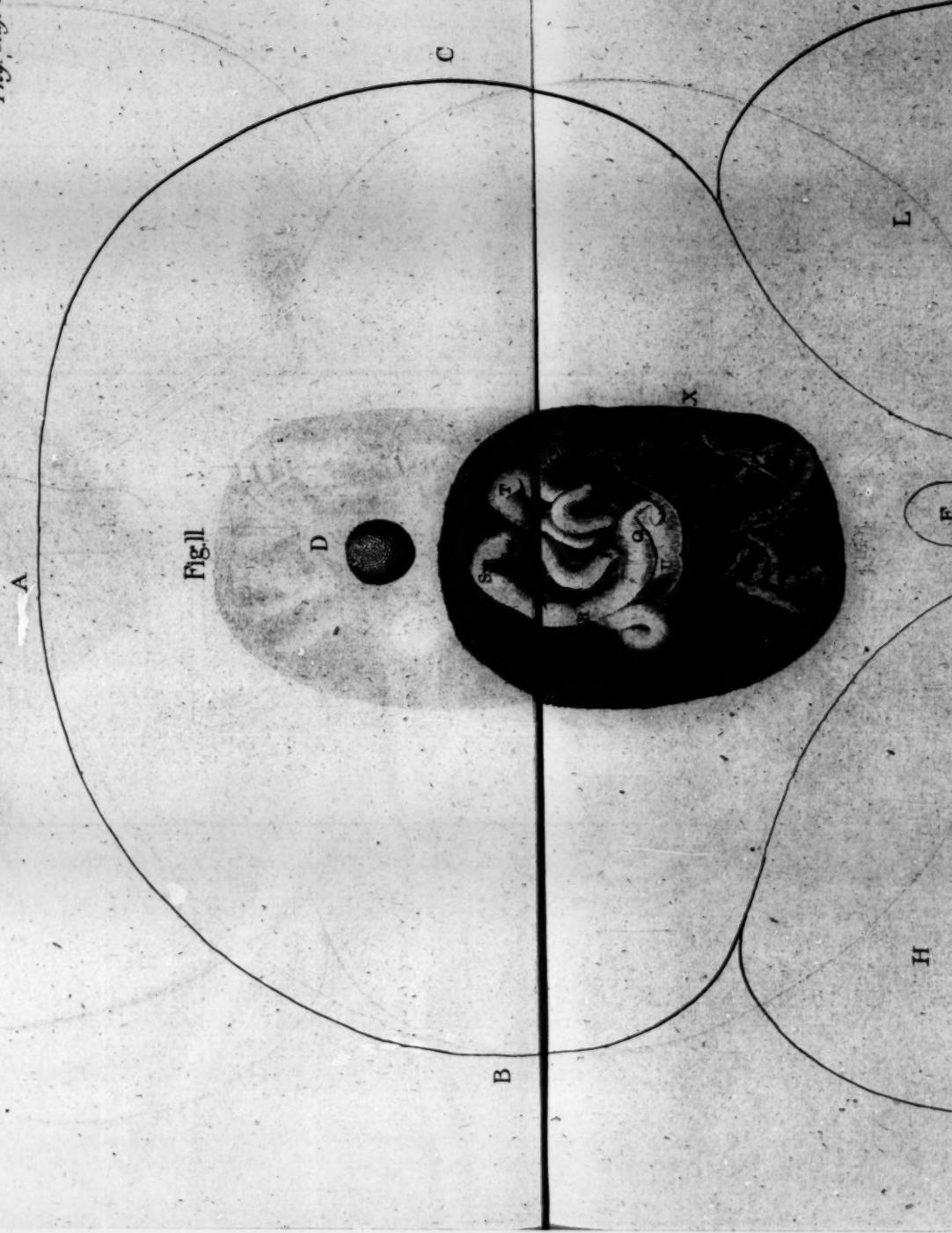
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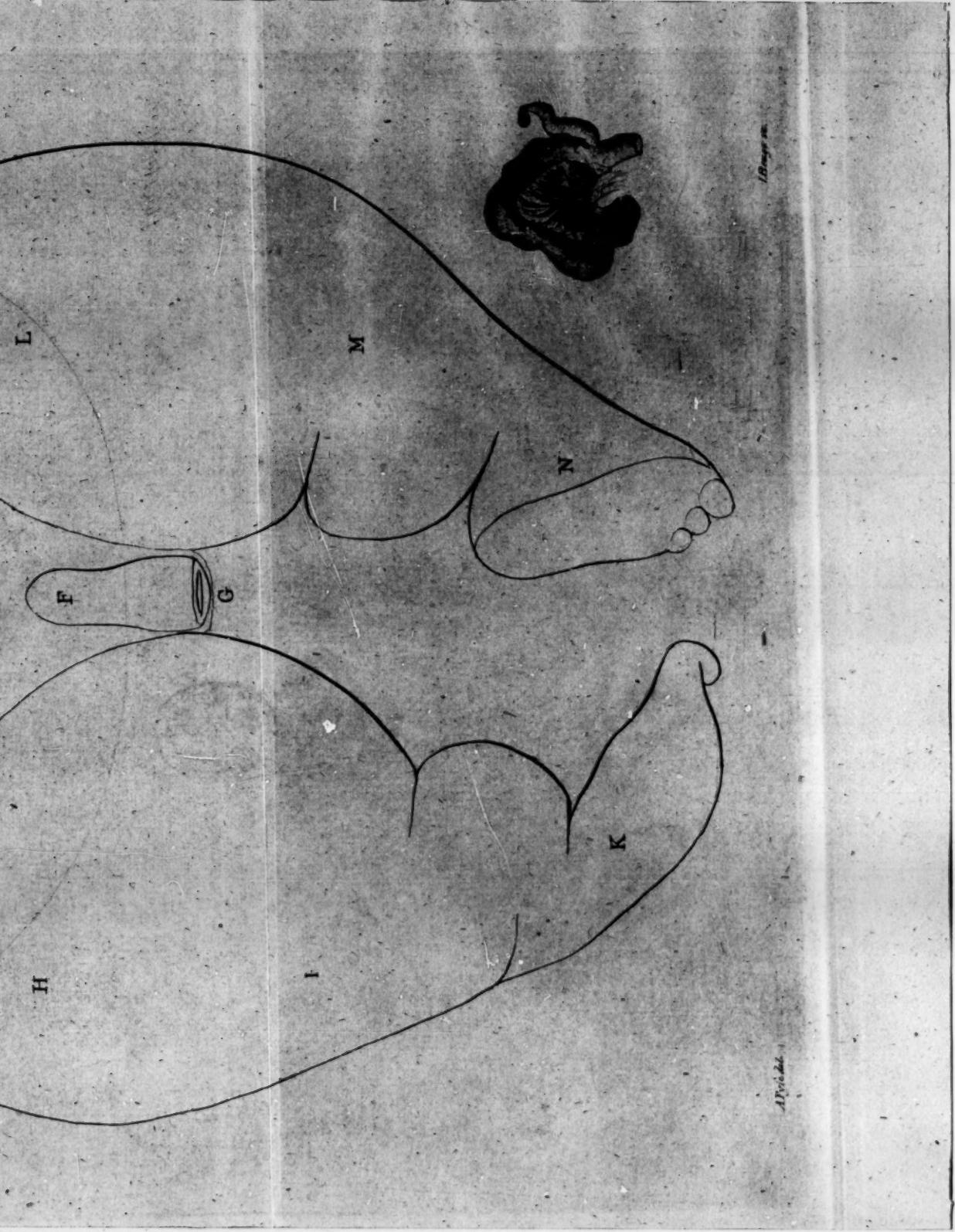


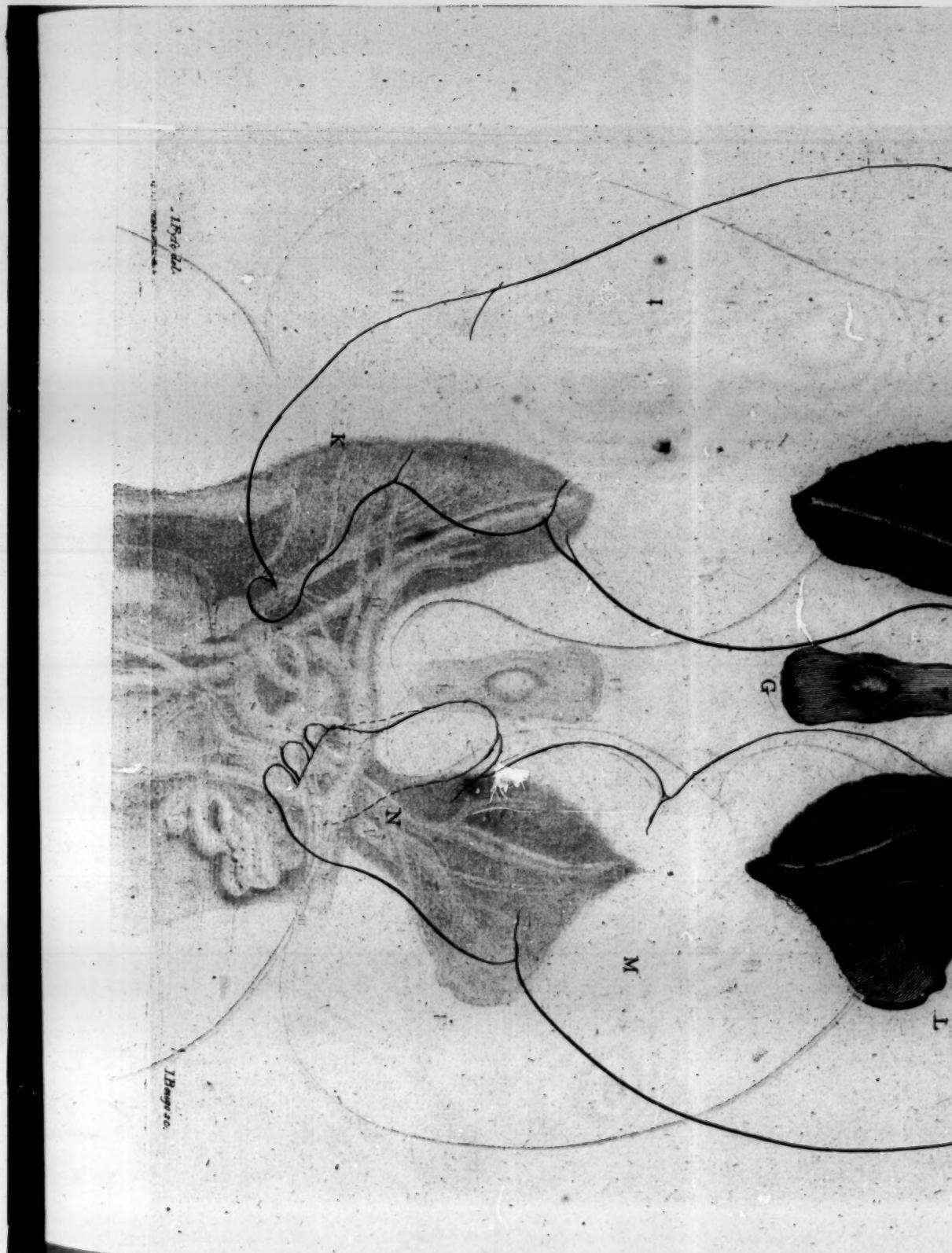


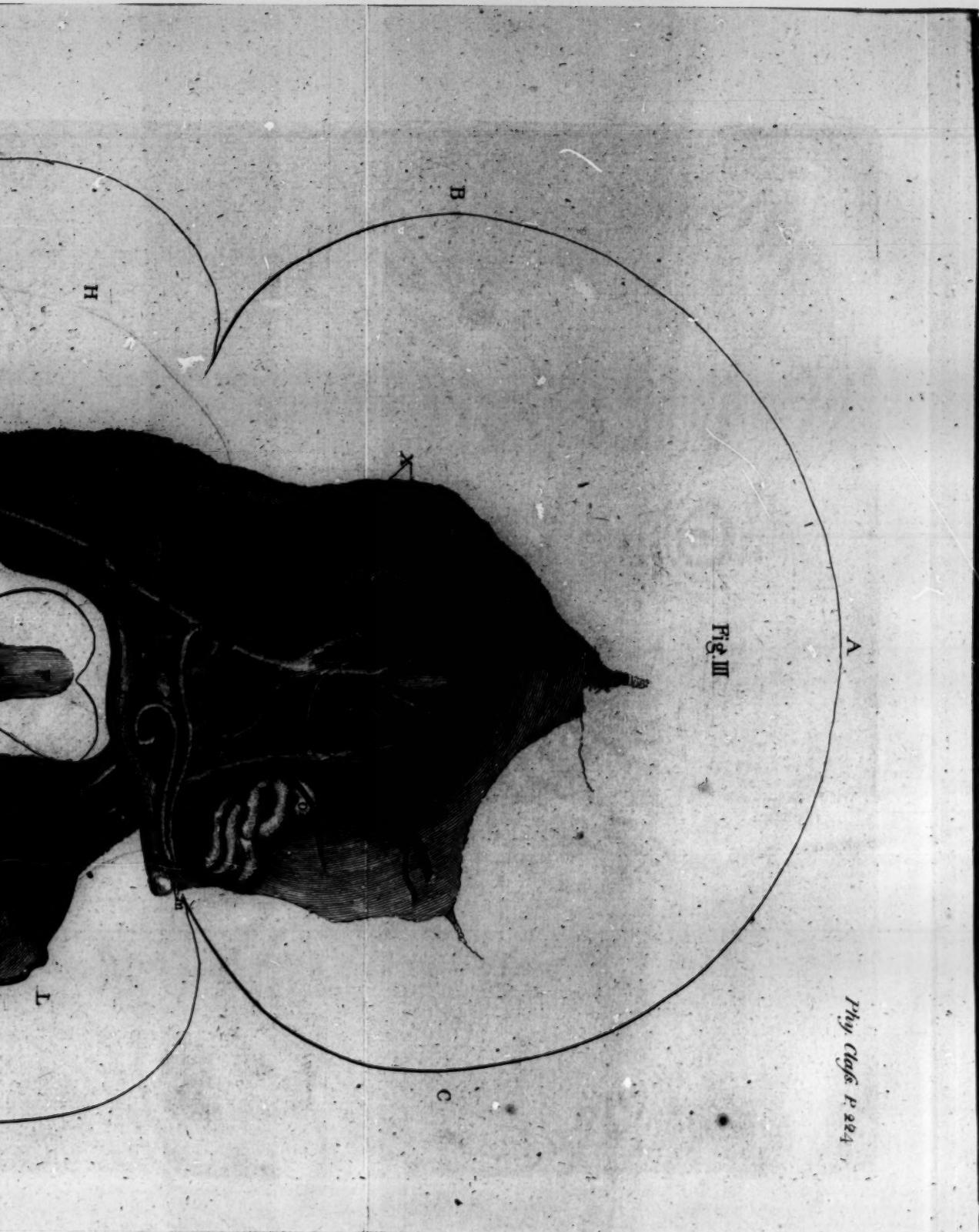
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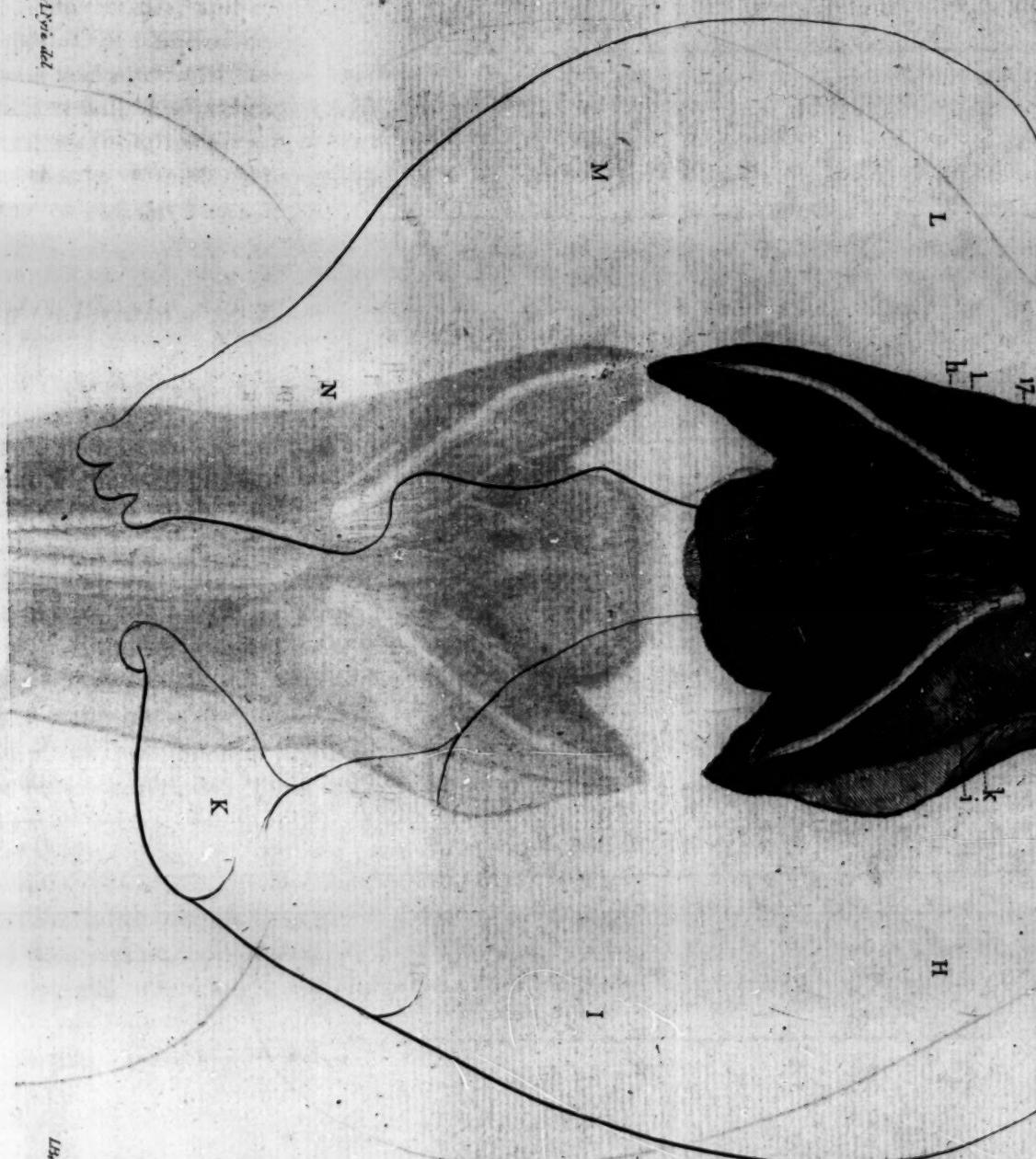
Fig. II











L. H. Baugniet, Jr.

A. J. V. de la

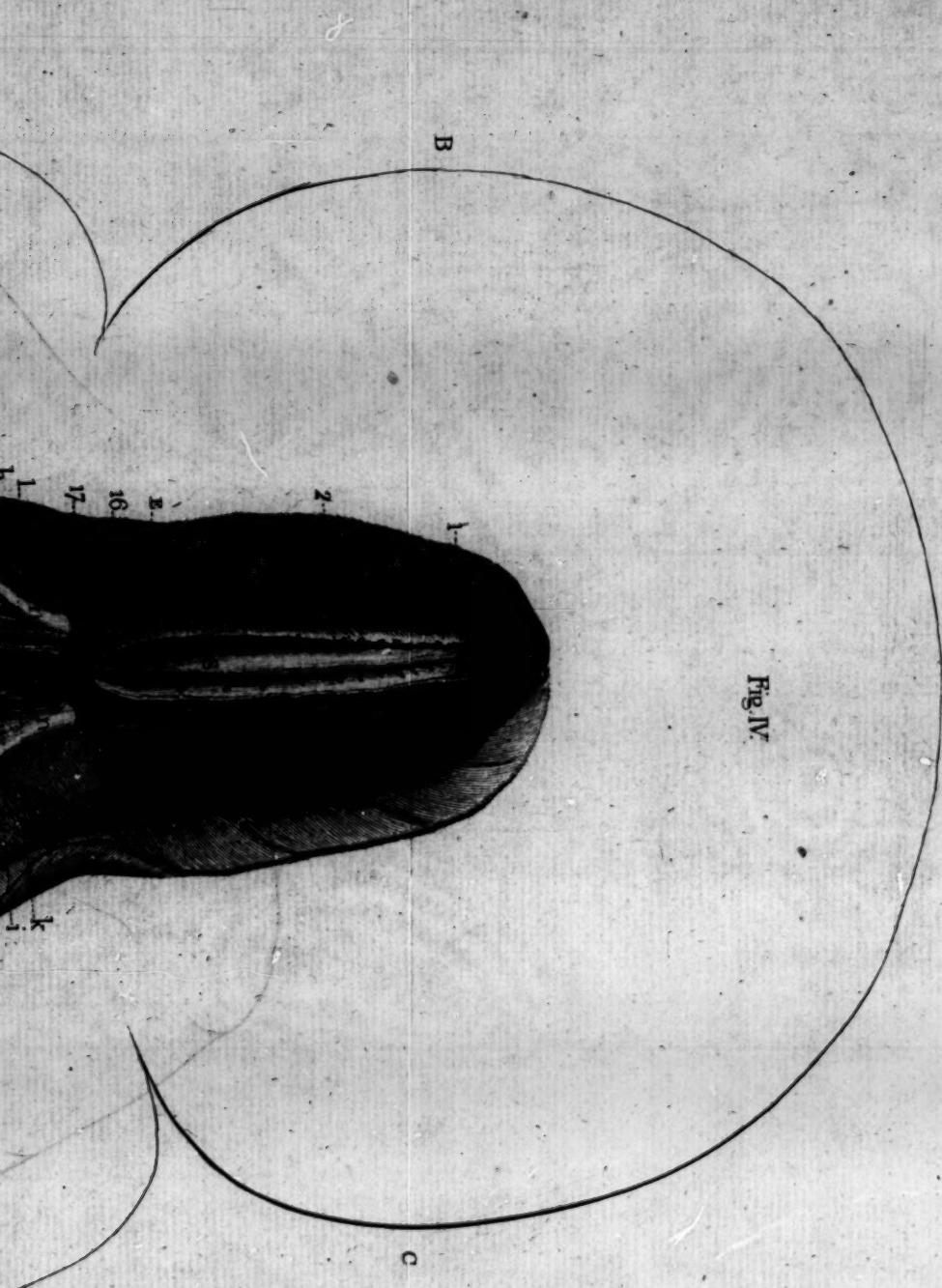
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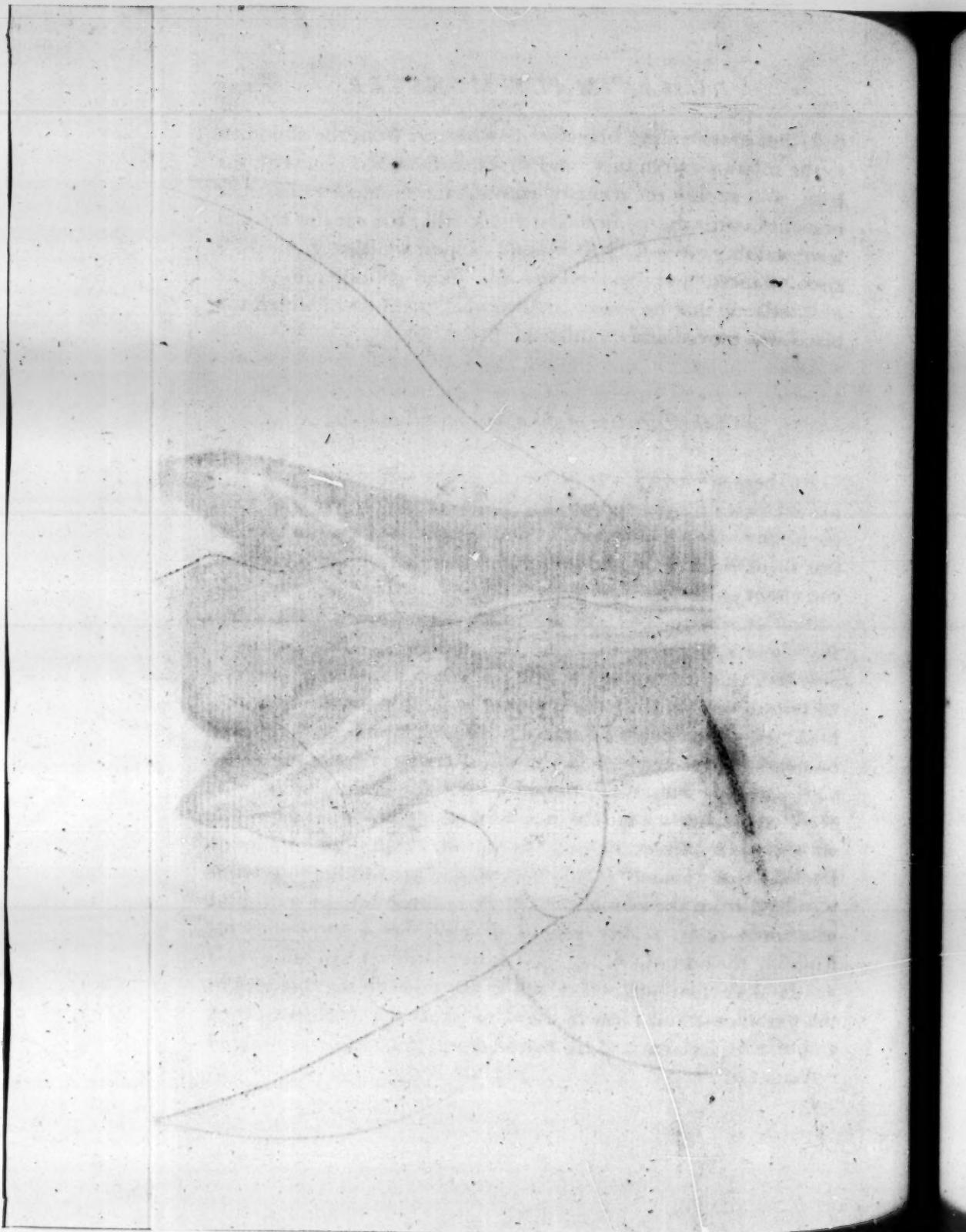
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Fig. IV.

B

C





describes it as sending branches downwards from the abdomen to the inferior extremities, and upwards from the thorax to the head, and applies the name of carotid arteries to two of these branches, with the additional remark, that the canales carotici were wanting, it will, I apprehend, appear evident from these circumstances, and from what I am about to observe in the next section, that he misunderstood the direction in which the blood was moved and circulated.

Of the Direction of the Blood in this Monster.

As there are two kinds of vessels in the umbilical cord, and likewise within the body of this monster, which we shall call, in the common style, arterious and venous, we cannot doubt, that these communicated with each other, and that the blood was conveyed by them in a circle.

To describe the circle more exactly, we cannot doubt, that the blood was conveyed from the placenta by the umbilical vein into the body of the monster. We next found, that the umbilical vein within the monster was divided into various branches, which could be traced to all its parts, or that these branches performed the office of arteries, or resembled the vena porta hepatica. Contiguous to these branches, we found, every where, other vessels which formed a trunk or large vessel, which, by its situation, resembled our aorta. But we must suppose, that these branches served the purpose of receiving the blood from the extremities of the branches of the umbilical vein, or were in reality venous vessels. From the vessel resembling the aorta in situation, but very different in office, two vessels were sent off, which ran at the sides of the bladder to the umbilicus, and formed the arteries of the umbilical cord and of the placenta, and, in the placenta, must have terminated

in the minute beginnings of the umbilical vein, to complete the circle in which the foetal blood was moved.

THUS, we observe the umbilical vein in the placenta and umbilical cord performing the office of a vein, but its continuation within the body of the monster, performing the office of an artery. On the other hand, we find the vessel we have called aorta, performing the office of a vein within the monster, and that of an artery in the umbilical cord and placenta.

Of the Causes of the Motion of the Blood in this Monster.

IN the monster examined by WINSLOW, which I have endeavoured to shew agreed very nearly with that I have described, no red blood was found in any of the vessels; and therefore we must conclude, that none of the red arteries of the mother anastomosed with the umbilical veins; and even where there is the ordinary structure, it is so far from being certain, that the vessels of the uterus, which convey red blood, anastomose with those of the umbilical cord, that the contrary is the most probable opinion.

IT is therefore very improbable, that the blood in the umbilical vein was pushed on by the heart of the mother.

FURTHER, though we were to admit, that the arteries of the mother anastomosed with the umbilical veins, yet, as their communications must be supposed very minute, and the momentum of the blood in them very much broken, we cannot conceive, that it could have been sufficient to push the blood through the terminations of all the branches of the umbilical veins, in the several organs of its body, into the vessel we call aorta, and again from the aorta back to the placenta by the umbilical arteries, and through the minute branches of these to the veins of the mother, and beginnings of the umbilical veins.

Wz

We therefore must conclude, that the circulation of the blood in the placenta and body of the monster, was carried on by a well regulated muscular action of the blood-vessels. In one of the worms, the *echinus esculentus*, I found in the mesentery, which is a principal part of it, two such large vessels without a heart, and which, we can scarcely doubt, resembled our aorta and cava, and circulated its fluid; and in fishes*, the blood which passes through the liver describes three circles, and in all other parts of the fish the blood describes two circles before it returns to the heart; which motion of it we must suppose to be chiefly owing to the muscular action of the vessels, as the force of the heart appears to be as much spent in the gills of the fish as in the lungs of a man.

FROM considering the manner and cause of the motion of the blood in this monster, and comparing with it the motion of the blood in fishes and in the sea egg, we are, by analogy, led to the following general conclusions :

1. THE arteries contribute much to the circulation of the blood in our bodies.
2. It is probable that, in man, the veins likewise assist in circulation; and, in particular, there can be no doubt, that the *vena portarum*, by its action, contributes much to the motion of the blood through our liver.
3. FOR the like reasons, we may conclude, that arterious vessels, independent of the impulse of the heart, may act in such a manner, as to perform the secretion of liquors, to nourish the solids, and to add to their bulk; and particularly, that the branches of the *vena portarum* change certain parts of the blood into bile.

F f 2

Remarks

* See MONKO on Fishes, p. 67. Tab. xlviij.

Remarks on the Nervous System of this Monster.

1. As the spinal marrow, and pairs of nerves sent off from it, had nearly the usual size and structure, although the brain, cerebellum, and medulla oblongata, were entirely wanting, we find reason for calling in question the common doctrine of authors, which teaches, that the spinal marrow and nerves derive their origin from the brain and cerebellum, and are dependent upon it as much as the ducts of glands are upon the glands which send liquors into them.

2. FURTHER, as the several parts of this monster were furnished with nerves, and as we have found, that its arteries and veins, by a well-regulated, varied and complicated action, circulated the blood, we must suppose, that their muscular fibres were actuated by those nerves. We therefore find in this monster, not only the existence and common appearance of the spinal marrow and nerves connected with it, although the brain and cerebellum were wanting, but we have proof that these, independent of the brain and cerebellum, may actuate the muscular fibres in the vessels of an animal, or that nervous energy, or fluid, as it is commonly called, is not derived from the brain and cerebellum solely ; that is, we conclude, that the nerves, as well as the brain and cerebellum, are capable of furnishing nervous energy ; and that there is no more reason for believing, that the nerves are derived from the brain, than that the brain is derived from the nerves ; or all the parts and branches of the nervous system appear to possess the general power or office of furnishing nervous energy.

Of

Of the Duration of the Life of this Monster.

As in man and similar animals, the direct or indirect influence of respiration seems necessary for the continuance of life, and as the lungs were wanting in this monster, we must suppose, that it could have outlived the separation from the mother for a very short time only. But when we add to this, that, by the ligature of the umbilical cord, a stop would be mechanically put to the circulation of its blood, it is evident, that its life must have terminated with its delivery.

Of the Time at which this Monster must have acquired the Structure which has been described.

As this monster was provided with a distinct placenta and membranes, and its body surrounded with and protected by the liquor amnii ; as no vestige appeared of the brain, cerebellum, organs of the senses, or other parts of the head ; as nervous threads, proper to this monster, ascended from the upper end of the spinal marrow towards the upper parts of its body ; as its system of circulating vessels was complete without a heart, and the manner of their branching different in many respects from the common structure : it must surely appear, to an unprejudiced person, absurd to suppose, with many eminent authors, that such monsters, when first produced, had the ordinary structure, and that this was afterwards altered by pressure and other accidents.

THE like observation may be extended to many other monsters in my possession, I believe I might say to almost all other monsters

monsters which have been described; particularly to two, of which I published a description, illustrated with figures, in my work on the Nervous System. In one of them, a human monster, one heart supplied two heads and two trunks. In the other, a kitten, one heart, consisting of two auricles and two ventricles, sent off from its left ventricle one aorta, which supplied one head and two bodies *.

* See Observations on the Nervous System, Tab. viii. ** and Tab. xii.

X. EXPERIMENTS relating to ANIMAL ELECTRICITY. By
ALEXANDER MONRO, M. D. F. R. S. EDIN. Fellow of the
Royal College of Physicians, Professor of Medicine, Anatomy
and Surgery in the University of Edinburgh, Fellow of the
Royal Academy of Surgery in Paris, &c. &c.

[Read Dec. 3. 1792.]

ON the 3d of November last, Sir JAMES HALL and Dr Rutherford asked me to repeat with them some experiments on what has been called Animal Electricity, which were first performed by Dr GALVANI, Professor of Anatomy at Bologna, and of which an account had been communicated by Mr SEGUIN of Paris to Dr BLACK, in a letter dated Paris, 3d August.

WE accordingly, with the help of my assistant Mr FYFE, repeated them in the following manner :

WE cut a living frog into two parts, a little above the lower end of the spinal marrow. We then put the middle part of a bit of tinfoil, about one-tenth of an inch in breadth, and two inches long, under the beginning of one of the sciatic nerves, and then doubled the tinfoil over the nerve, that is, we included the nerve in the doubling of the tinfoil. We next placed one half-crown silver piece between the table and loins of the frog, and another between the table and its leg. We then bended a piece of brass-wire, about the size of a common stocking-

stocking-wire, and after laying one end of it upon the half-crown piece which supported the leg, we with the other end of the wire pressed the doubled tinfoil against the half-crown piece which supported the loins, and found, that instantly convulsions were produced in the muscles of the thigh and leg.

WHEN the tinfoil was passed around both sciatic nerves, both legs were convulsed, although the half crown piece was placed under one of the legs only. These experiments were tried more than an hour after the spinal marrow had been cut across, with the same success.

IN another frog, in which the spinal marrow was not divided, we found the same means produce the same effects upon the legs, but did not observe, that the muscles above the tinfoil in the trunk or fore-legs were affected.

WHEN the touches were quickly repeated, the motions seemed to become, by degrees, less vigorous, but did not cease after repeating them often, even where the spinal marrow had been divided transversely.

ON the 10th of November, I prosecuted the subject farther by the following experiments :

EXPERIMENT I.

AFTER cutting off the hind legs of a living frog, I laid bare the upper part of its spinal marrow, and surrounded it with tinfoil; and in another frog, after laying bare the brain, I thrust into it a bit of tinfoil. I then placed one half crown piece between the table and the body of the frog, opposite to the tinfoil, and another half crown piece between the table and the lower part of the trunk of the animal, and, on applying the wire, as before, I found convulsions produced in the fore-legs and body. Gold had nearly the same effect as silver; but the

convulsions were much less observable, when lead, iron or copper were substituted instead of these.

EXPERIMENT II.

I NEXT tried all the above mentioned experiments with one half-crown piece only, placed opposite to the tinfoil; and on pressing the tinfoil against the silver-piece, by means of a brass-wire which I held in my hand, I found, that the muscles were convulsed exactly in the same manner as where two pieces of the silver were employed in the manner before mentioned.

EXPERIMENT III.

I FOUND likewise, that the experiment succeeded equally well, although the silver-piece did not touch the body of the animal, but was merely brought into contact with the tinfoil put around the nerve, by pressure with a brass-wire held in the hand.

EXPERIMENT IV.

AFTER inclosing the upper part of the sciatic nerve in tinfoil, I tied a linen-thread around it, where it is about to pass from the trunk into the thigh, so tight as to deprive the muscles of their power of acting by the ordinary exertions of the animal, and the skin and toes of their feeling, yet when, with a brass-wire held in my hand, I pressed the tinfoil against the silver-piece, the muscles of the limb were violently convulsed.

E X P E R I M E N T V.

I DIVIDED transversely all the parts of a frog at the pelvis, then tied together the divided parts of one of the sciatic nerves with a linen thread. I afterwards passed the tinfoil around the nerve, at a considerable distance above the ligature, and found, that when, with a brass-wire, I pressed the tinfoil against a half-crown piece, laid on the table at a little distance from the frog, the muscles of the leg were instantly convulsed.

E X P E R I M E N T VI.

WHEN, after dividing both sciatic nerves transversely, I tied the upper part of the right sciatic nerve, inclosed in the tinfoil, to the lower part of the left sciatic nerve, and then, with a brass wire, pressed the tinfoil against a piece of silver, the muscles of the left leg were convulsed.

E X P E R I M E N T VII.

THE event was the same when the divided parts of the nerves were crossed over each other, without being tied together.

E X P E R I M E N T VIII.

THE event was the same, when the animal, with the metals, were placed on the top of a large glass-jar inverted, or on a plate of window-glass, supported on two pieces of sealing-wax.

E X P E -

EXPERIMENT IX.

I PASSED the tinfoil around portions of the skin, the muscles, the intestines, and around the femoral blood-vessels of frogs, without observing convulsions produced, when the tinfoil was applied to the silver by means of the brass-wire.

EXPERIMENT X.

I LAID bare the sciatic nerve in the back part of the thigh of a young rabbit, and inclosed it in tinfoil, and then applied the tinfoil, by means of a brass-wire, repeatedly to a half-crown piece, laid on the table, and observed convulsions of the leg produced on each application. I after that cut transversely the lower part of the spinal marrow, and then, with a brass-wire held in my hand, I pressed the tinfoil again to the silver, and kept it applied for a few seconds, which occasioned convulsions so quickly repeated, that the leg became rigid. Immediately thereafter, the muscles were relaxed, and their contractile power seemed to be exhausted, as repeated applications of the tinfoil to the silver produced no farther motion of the limb.

REMARKS AND QUERIES.

FROM the accounts we have received of the experiments of Dr GALVANI and Dr VALLI, it appears, that both these celebrated authors have supposed, " That the circulation of the " nervous fluid from the nerves to the muscles, is nearly similar " to the circulation of artificial electricity in the Leyden phial ;

" and as the circulation of the Leyden phial supposes two contrary electricities, the one more condensed or positive, and the other less so or negative, so Professor GALVANI concludes, " that a similar distinction takes place in the bodies of animals, " and that one of these electricities, to wit, the condensed or positive, is seated in the nerves, and the other in the muscles*."

HENCE both of them have conceived it necessary, to establish a communication between the nerve and the muscle, by means of metalline coating of the nerve and pieces of metal and metalline conductors; or by coating the nerve with lead or tin, then laying one piece of silver in contact with the tin, and another in contact with the muscle; and, in the last place, establishing a communication between the two pieces of metal, or between the nerve and the muscle, by means of a brass-wire, which they term a conductor†.

BUT, instead of this complex apparatus, I have found, from the above experiments, that the muscle is thrown into action, although no metal is directly in contact with it, or when the communication between the metals and the muscle is made by the nerve alone.

It appears therefore, that Professor GALVANI and Dr VALLI have allowed preconceived theory to conduct their experiments, instead of allowing their experiments to conduct their theory; in consequence of which, several of their experiments have been performed with less accuracy than might have been expected. Thus, they tell us, that if the conductor is first applied to the muscle, the convulsions are stronger than when it is first applied to the nerve; that the shocks are stronger when the feet communicated with the earth, &c. whereas the application of the conductor to the muscles, or of the feet to the earth, are quite out of the question.

2. We

* See Medical Facts and Observations, Lond. 1792. p. 187, 188.

† Ditto, p. 187, 191, 211.

2. WE have found, that when a piece of silver is brought in contact with the tinfoil coating of a nerve, the muscles in which that nerve terminates, are thrown into action, although the nerve has been surrounded with a tight ligature between the coating and the muscle, or even although it has been divided by a transverse incision, provided the divided parts are again brought into contact, or tied together by a thread.

3. WHEN we tie the coated nerve, after it is cut transversely, to another nerve which has been cut transversely, we have found, that the muscles supplied by the latter are thrown into action.

4. AFTER the spinal marrow and whole body of the frog were divided transversely about the middle of the back, and the tin coating and silver were applied to the sciatic nerve, I did not observe, that the muscles at the loins and pelvis were thrown into action, or the effect produced by the metals did not influence muscles supplied by branches of nerves sent off from the spinal marrow or sciatic nerves above the coating.

It appears, that the nerve of a living animal, whether entire, or cut and rejoined, conducts that matter by which the muscle is influenced more readily than the skin, the flesh or the blood-vessels do.

5. ALTHOUGH, on repeating Dr GALVANI's experiments, it should be proved, that electrical matter, drawn from a cloud or excited by the common machinery, and conducted to a nerve, and that matter, which is put in motion by the application of certain metals to each other and to a nerve, produce similar motions in the muscles in which the nerve terminates, we are not at liberty to take for granted, as GALVANI and VALLI seem to have done, that the electrical matter and this matter are the same, as the nerves may be affected by stimuli of different kinds.

6. As an animal does not feel nor act by the medium of a nerve which has been divided transversely, although its divided parts are placed contiguous, or tied together; as the muscles supplied by nerves above the place coated are not thrown into action; the above experiments, or those of GALVANI and VALLI, instead of proving, as they have supposed, that the matter which is excited is electrical, and the fluid of the nerves the same with it, appear to show, that the electrical fluid, or matter put in motion by the different metals, is quite different in its nature from the nervous fluid, as the course of the nervous fluid, but not that of the electrical, can be intercepted by ligature or incision of the nerve.

7. As the action of the muscles, in the above experiments, is not produced, nor even increased, by connecting the coating of the nerve with the muscle by means of a wire, there is no foundation for the opinion of GALVANI and VALLI, that the nerve is electrified plus, and the muscle minus, or that the electricity of the one is positive, and that of the other negative.

8. We seen: therefore to be led to the conclusion, that the matter or fluid which is excited or put in motion by the application of the different metals to each other, and to the nerve, serves merely as a powerful stimulus to that energy or fluid which is lodged in the nerves.

To support this way of reasoning, we may observe, that in a warm-blooded animal, the rabbit, although convulsions were repeated for a considerable length of time when the nerve was entire, yet, after dividing the nerve and intercepting the further supply of nervous energy from the brain, the action of the muscles ceased in a few seconds, by keeping the two metals contiguous, which is readily explained on the supposition, that the nervous energy or fluid, lodged in the nerve beyond the

place of the incision, was exhausted; and Dr VALLI himself, by observing, that, after the electricity, as he calls it, of a limb is exhausted, if the coating of a nerve be moved higher up, the action of the muscles may be renewed *, furnishes a fact which, I apprehend, may be explained on the same principle.

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* Medical Facts and Observations, Art. xx. p. 218.

[PICTURES OF EARTHQUAKES]

**XI. An Account of repeated Shocks of EARTHQUAKES felt at
COMRIE in PERTHSHIRE, in a Letter to the Reverend
Mr FINLAISON, F. R. S. EDIN. from Mr RALPH TAYLOR.
Communicated by Mr FINLAISON.**

[Read April 5. 1790, and Feb. 4. 1793.]

DEAR SIR,

Ochtertyre, Jan. 19. 1790.

THE earthquakes which have lately taken place at Comrie* and its neighbourhood, are certainly very deserving of attention. I shall therefore cheerfully comply with your request, and give you as particular a description as I can of such of them as have been most remarkable. To give a particular account of all the *noises* or *concussions* which, during the last half-year, have been heard or felt at Comrie, and within a short distance to the north, east and west of that village, is beyond my power, and would indeed be of little use. With regard to these small concussions, it will be sufficient to say, that many of them have sometimes been observed to succeed one another in the space of a few hours; that they take place in all kinds of weather; that they are thought by some people to proceed

from

* Comrie is a village about twenty-two miles west of Perth, situated in the valley of Strath-Earn, and on the north side of the river Earn, about four miles below the place where it issues from the lake. The remains of a Roman camp on the opposite side of the river, have made the name of this village very well known to Scottish antiquaries.

from N. W. to S. E. and by others from N. E. to S. W.; that they have not been observed to affect the barometer; that they do not extend in any direction above three or four miles from Comrie; and that towards the south they are bounded by the Earn, which is in the immediate vicinity of the village. The same person, though bestowing the minutest attention, is often uncertain whether they proceed from the earth or from the air, sometimes believing them to come from the one, and sometimes from the other; neither do all agree with respect to the seat of any one of them.

AFTER the strictest enquiry, I find it impossible to determine with accuracy the date of any of the concussions which took place before the 2d of September last. Some people in the neighbourhood of Killin assert positively, that they heard unusual rumbling noises in the month of May; but the impression which these noises made was so faint, that they would probably have been soon forgotten altogether, had they not been succeeded by concussions of a less equivocal nature. Towards the end of August, two or three shocks are said to have been felt at Dundurn, Dunira Lodge and Comrie; but I have not been able to learn the precise day, or hour on which any of them happened. The truth is, the concussions hitherto observed were feeble, and the minds of the people seem not to have been roused to particular attention till the 2d of September. About eleven o'clock that evening, a smart shock was felt at Comrie. I myself heard here, for the first time, a rumbling noise, which I took for that of a large table, dragged along the floor above stairs, and which I probably would never have thought of again, unless my attention had been turned to it by the alarm which it had excited in the neighbourhood. Many other feeble noises or concussions are said to have been observed in Glen-Leadnach and about Comrie during the months of September and October. At that time, however, I confess I was disposed to doubt the numerous reports of earthquakes with which the

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country

* Ochertyre is about four miles E. N. E. from Comrie.

country was filled, and to ascribe them to the workings of an imagination, on which the alarm of the 2d of September still continued to be impressed.

ON the 5th of November, a concussion took place two or three minutes before six o'clock P. M. which was too violent to be mistaken. Some compared the noise which accompanied it to that of heavy loaded waggons, dragged with great velocity along a hard road or pavement, and thought, that it passed under their feet. To me it seemed as if an enormous weight had fallen from the roof of the house, and rolled with impetuosity along the floor of the rooms above; and it must have made a similar impression on the servants, for some of them instantly ran up stairs to discover what had happened. Others were sensible of a tremulous motion in the earth, perceived the flames of the candles to vibrate, and observed the mirrors and kitchen-utensils placed along the walls to shake and clatter. There is also reason to believe, that the waters in the Loch of Monivaird, in the near neighbourhood of Ochtertyre, suffered unusual agitation, as the wild fowl then upon the loch were heard to scream and flutter. The noise on this occasion, as far as I can judge, did not last above ten or twelve seconds. During the course of the day, the mercury in the barometer rose and fell several times, and at six o'clock it stood at $28\frac{1}{2}$ inches. The sky was then perfectly serene, and hardly a breath of wind was to be felt; but next morning, about six o'clock, a violent tempest rose, which raged without intermission for twenty-four hours.

AT Glen-Leadnach, Comrie and Lawers, this concussion was much more violent, and the noise that accompanied it much more alarming. The inhabitants of these places, and of Aberuchill and Dunira, declare, that they perceived distinctly the earth heaving under them, and the motion communicated to their chairs, and other furniture. They imagined that the slates and stones were tumbling from their houses, and many of them ran out in the greatest trepidation, from the notion,

notion, that the roofs were falling in. Even the domestic animals were alarmed, and contributed, by their howls and screams, to increase the terrors of the people. Though I have not been able to discover whether *Loch Earn* was ever agitated by these concussions, there is little doubt, that the *river* near Comrie was affected on this occasion, as two men then on its banks heard the dashing of its waters. This great shock was succeeded by a number of those slighter rumbling noises which have been already mentioned. Not less than thirty of them were counted in the space of two hours after it happened; but they did not extend above two miles to the east, north and west of Comrie.

ON the 10th of November, at three o'clock P. M. we had here another shock of much the same length, violence and extent, as that on the 5th. The mercury in the barometer on this day was more stationary than on the former, and at the time of the earthquake was 29 inches high. The weather was calm and hazy. It was a market-day at Comrie; and the people, who were assembled from all parts of the country, felt as if the mountains were to tumble instantly upon their heads. The hard-ware exposed for sale in the shops and booths shook and clattered, and the horses crowded together with signs of unusual terror.

ABOUT one o'clock P. M. of the 29th December, we had another pretty smart shock, during a very violent storm of wind and rain, which continued the whole day, and which was at its height during the time of the earthquake. Indeed, as has been remarked already, these concussions seem to have no dependence on the weather. According to the accounts of those who live nearest to the centre of the phenomena, rumbling noises, like those above described, may be heard in all states of the atmosphere.

THOUGH I mention no more of these earthquakes, you are not to conclude, that many more have not taken place, and some of them perhaps equally violent with those of the 5th and 10th

of November. Several shocks have happened during the stillness of the night, which, even at this distance from Comrie, where their centre seems to be, have been abundantly terrifying. But the great resemblance, or rather the perfect similarity of their effects, and of the impression they make on our minds, renders it unnecessary for me to trouble you with a particular description of each of them.

THE direction of all the noises or concussions I have observed, great as well as small, appeared to be in the same line from N. W. to S. E. Others describe them as sometimes proceeding in that direction, and sometimes as coming from N. E. to S. W. I have not heard any other line of direction ascribed to them.

UPON the fullest enquiry, I find, that these earthquakes have been very limited in point of extent. The greater shocks have been feebly felt at Loch Earn head, about Killin, and at Ardonich, on the southern bank of Loch Tay. They do not appear to have extended farther eastward on that lake; and, what is more remarkable, they have not been felt in Glen-Almond, or the small glen through which the military road from Crieff to Tay bridge passes. The farmer at Auchnafree, (which lies at the head of Glen-Almond, and is separated from Glen-Leadnach only by the mountain Benechoni, over the northern side of which his shepherds daily travel), has assured me, that neither he, nor any of his people, have been at any time sensible of the least extraordinary noise or concussion. Towards the east, the two first great shocks extended to Monzie, Cultoquhey and Dollar, about seven miles distant from Comrie. The shock of the 5th of November reached still farther, and was felt, though but faintly, at Ardoch and Drummond Castle towards the S. E. In the direction of the south, however, the banks of the Earn seem to be its general boundary, as the noise of the most violent concussions was heard but faintly at the *manse* of Comrie, and along the *strath* on the south side of the river. The limits of the lesser concussions, I am confident, do not extend above three miles in any direction

rection from their centre. They are commonly observed at Lawers on the east ; throughout the whole of Glen-Leadnach, at Dunira, Dalchonzie and Aberuchill, on the north and west ; and do not reach so far as the *manse*, which is about three quarters of a mile on the south of Comrie *.

I am, with great regard,

DEAR SIR,

Your's most sincerely,

RALPH TAYLOR.

P O S T S C R I P T.

Duddingstone House, Jan. 24. 1793.

THERE is no reason to believe, that these phenomena are yet come to an end. After temporary intermissions, sometimes of several months, they have returned, ever since their first appearance in 1789, without any apparent difference in their extent

* THE tract within which the concussions described in this letter appear to have been confined, is a space of a rectangular form, which extends from east to west along the north side of the Earn about 22 miles in length, by a little more than five in breadth ; reckoning the utmost length from about Monzie to the head of Loch Tay, and the breadth from a little south of the Earn northward to the ridge which separates the branches of that river from those of the Almond. The whole of this tract is mountainous, except toward the eastern extremity, where it joins the low country, and on the banks of the river Earn on the south. It is intersected by narrow glens or valleys, the most considerable of which is Glen-Leadnach, where the centre of the concussions seems to be placed. The mineralogy of this part of the country has not hitherto been accurately examined ; but it is known in general, that the stone is the primary schistus, and in some places granite ; that no mineral veins, nor any hot springs, have been found in it, and that no volcanic appearances have been observed. In the valleys, among the mountains, iron ore, of the kind that is called bog ore, is said to abound. Dr HUTTON has remarked, that the line which terminates this tract on the S. E. seems to be nearly the same with that where the primary strata sink under the surface, and are covered by the secondary, or horizontal strata. J. P.

extent or force. The rumbling noises or slighter concussions, as usual, are observed at Comrie, in Glen-Leadnach, and the places in their near neighbourhood ; the more violent extend to much the same distance as formerly described. Having been only occasionally in that country since February 1791, I have not been able to ascertain dates. On the 2d of September 1791, at five minutes past five in the afternoon, a slight shock was felt at Ochtertyre. The barometer was not in order, on which account the weight of the atmosphere could not be ascertained. Its electrical state was tried by SAUSSURE's electrometer, but no indication of any thing uncommon was perceived. Since that period, shocks have been observed at different times till within these few weeks past.

FROM this account, it will be observed, that all the greater shocks have taken place in the season of autumn or the beginning of winter ; that this has been now repeated for more than four years ; and that those greater shocks have been succeeded at short intervals by rumbling noises or more feeble concussions. It has also been remarked, that they have in general been preceded or followed by great rains or boisterous weather ; but variations in the weather take place so frequently in our climate at that season of the year, that the connection between them and the phenomena above described, is probably altogether accidental.

R. T.

XII. *A DESCRIPTION of an IMPROVED THERMOMETER.* Communicated by DANIEL RUTHERFORD, M. D. F. R. S. EDIN. Professor of Medicine and Botany in the University of Edinburgh.

[Read April 5. 1790.]

THE following improvement on the construction of the thermometer, by which it is fitted to mark the lowest or the highest point to which the fluid has attained in the absence of the observer, is due to JOHN RUTHERFORD, M. D. of Middle Ballilish. This gentleman communicated it to me some time ago, and accompanied the description with one of his thermometers. The contrivance is so very simple and ingenious, that it well deserves to be made public. I therefore, by permission of the author, beg leave to lay an account of it before the Royal Society.

I. IF it be required, that the thermometer should mark the lowest point to which the liquid has descended within any given time, a common spirit of wine thermometer must be provided, of a convenient size, such as is represented by the figure A B *. Into the tube is introduced a small conical piece of coloured glass or enamel, (C), with its point turned towards the bulb of the thermometer. This piece is about $\frac{1}{2}$ inch long, and of such diameter at the base, that it may move freely within the tube,

yet

* See the figure, plate 4. at the end of No. XIII.

yet nearly fill the caliber. It is to be allowed to move downwards till it be fully immersed in the spirit. After this has once been effected, it will be found, that it is not disposed to part again from the spirit; but if the thermometer be held vertically, with the bulb uppermost, it will immediately descend to the extremity of the column, but no farther: There it rests; and if by a diminution of heat the spirit contract, it is drawn upwards at the extremity of the column, as this recedes towards the bulb. Now, let the thermometer be so disposed, that its stem, instead of being vertical shall be horizontal, (and such is the ordinary position of this thermometer). it may readily be imagined, that, in this case, the conical piece shall equally, as before, follow any retraction of the column; but should this lengthen again, in consequence of an increase of temperature, the conical piece does not advance with it, but remaining fixed at the lowest point to which the column had descended, it allows the liquor to pass freely beyond it, as that again expands. Hence the point of the scale at which the conical piece is found to rest, denotes the lowest degree to which the liquor of the thermometer has sunk in the interval of the observations. To rectify the instrument for a fresh observation, nothing farther is requisite than to elevate the bulb of the thermometer, in order that the conical piece may sink, by its proper gravity, to the extremity of the column.

2. If it be required, that the thermometer should mark the highest point to which the fluid has ascended in any given time, then a mercurial thermometer is to be employed, such as is represented by D E; into the tube of which is introduced a conical piece of ivory F, with its base turned towards the bulb. When such a thermometer is placed in a vertical situation, the bit of ivory will fall down, and rest upon the surface of the mercury in the tube; it will rise as the column is lengthened, and descend as this contracts. But if the stem be

placed horizontally, though the ivory will be equally pushed forwards by the mercury, while this is expanded by an increase of temperature, yet should the mercury again contract, the ivory will not follow it, but remain stationary, and consequently the point at which it rests will mark the highest degree to which the thermometer had risen. An instrument of this kind is rectified by bringing the stem into a vertical situation with the bulb undermost, then cautiously restoring it to a horizontal situation.

Two thermometers such as those above described, one filled with spirit of wine, and the other with mercury, may conveniently be disposed upon one frame. If their bulbs be situated at the opposite ends of the frame, or as represented by the figure, then both may be rectified by the same movement, and we shall have an opportunity of ascertaining, by the situation of the conical pieces in the different stems, both the highest and the lowest point which the fluids of the thermometers have reached during any interval of our observations.

XIII. OBSERVATIONS on the MUSCLES; and particularly on the
Effects of their OBLIQUE FIBRES. By ALEXANDER
MONRO, M. D. F. R. S. EDIN. Professor of Medicine, An-
atomy and Surgery in the University of Edinburgh, Fellow of
the Royal College of Physicians in Edinburgh, and of the
Royal Academy of Surgery in Paris.

[Read Jan. 7. 1793.]

AS it appeared to me, when I first began, in 1759, to deliver in this University a public course of lectures on Anatomy and Surgery, that the structure of the oblique muscles had not been sufficiently examined, nor even the number of them attended to by authors, and that some of their chief purposes or effects had been entirely overlooked by them, I endeavoured then, and in every course of lectures since that time, to direct very particularly the attention of students to those subjects.

I BEGAN with observing, as a material defect in the otherwise very accurate and elegant tables of ALBINUS, as well as in the former systems of VESALIUS, EUSTACHIUS, BIDLOO and COUPER, that the tendinous membranes or aponeuroses, with which many muscles, particularly of the extremities, are covered, and with which the oblique muscles are closely connected, were not delineated, yet that the knowledge of these is not only of use in the practice of surgery, but for understanding the action of the muscles.

I REMARKED, that although in some parts of the body, tendinous membranes, such as those between the cartilages of the ribs, or the aponeuroses palmares, or fasciæ latæ of the thighs, served merely for the defence of the parts, or as sheaths to them, as they were connected to them by the cellular substance only, yet, in general, they served, besides the mere purpose of defence, to furnish a greater extent of surface for the attachment of oblique fleshy fibres.

I SHewed them, that wherever tendinous membranes run longitudinally on the surfaces of muscles, fleshy fibres, placed obliquely, were found; that in many muscles, as in the semi-membranosus, or flexor pollicis longus, fleshy fibres passed obliquely from the inner part of the tendon on one side, to the inner part of the tendon on the other side of the muscle, or such muscles were semi-penniform, (See T. 1. fig. 1.); that in other muscles, as in the rectus extensor cruris, or flexor pollicis pedis longus, a third tendinous membrane was found in the middle of the muscle, between which and the inner parts of the tendons on the two sides of the muscle, the fleshy fibres passed obliquely, and produced a complete penniform appearance, (see T. 1. fig. 2.); and some muscles, as the soleus, might be called compound penniform, because, on cutting them lengthways, we discovered several longitudinal tendinous membranes, to both sides of which oblique fleshy fibres were connected. See T. 1. fig. 3.

I ALLEGED, that the direction, length and number of fibres in such muscles had not been sufficiently attended to by anatomists or by surgeons; and that, in many instances, the breadth of these muscles had been mistaken for their length; that in consequence of such inattention, they would find the celebrated LOUIS * attempting to discard the double incision of the soft parts in the amputation of the thigh, although, from the obliquity and shortness of the muscular fibres which cover

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* Acad. Roy. de Chirurg. T. 2. p. 357.

the thigh-bone, this improvement of CHESELDEN is more essential than in the amputation of the humerus, where the fleshy fibres, though oblique, are proportionally longer, and of course their retraction greater.

WHERE the fibres of muscles run obliquely, it is evident, and has been observed by BORELLUS and others, that the fibres will be more numerous than if the same space had been covered with longitudinal fibres; and although an oblique fibre will not raise a weight with the same force as a straight fibre, yet the number of the fibres may be so much increased by their obliquity, as to do more than compensate for the loss of force occasioned by the obliquity. Thus, let us suppose a longitudinal muscle to be five inches long, and one inch in breadth, and let us suppose it to contain in its breadth four fibres or ropes, each one-fourth of an inch in diameter, as in T. 2. fig. 1. the force of this muscle may be represented by the number 4.

LET us next suppose these ropes to be cut into pieces, each of which is one inch and a quarter in length, as represented by dotted transverse lines A, B, C, we shall, by doing so, form 16 ropes or fibres.

LET us next suppose, that these ropes, representing muscular fibres, are laid obliquely, like the hypotenuses of right-angled triangles, of which the bases are equal to one inch, and the height or perpendicular equal to three quarters of an inch, as in T. 2. fig. 2. each such fibre will, as BORELLUS has demonstrated, lose two-fifths of its force. But as there are 16 fibres instead of 4, their force will be as 16 multiplied by 3, to 5 multiplied by 4, or as 48 to 20, or as 12 to 5.

BUT that the mere increase of the number of fibres, or force of the muscles, which alone has been observed by authors, is not the sole purpose of nature, appears from this, that in some places, and particularly between the ribs, oblique fibres are employed, although it is evident, that a greater number of straight

straight fibres, or of fibres perpendicular to the ribs, might have been disposed in the same space.

THE other purposes of oblique muscles, and which had not been perceived by authors, are,

To perform much more extensive motions with the same degree of shortening of the fleshy fibres, than can be performed by straight muscles, or, with a less degree of shortening of the fibres, to perform motions of equal extent.

I SHALL now endeavour, in the first place, to demonstrate, that a pair of oblique muscles, placed between the same parallels with two straight muscles, perform, with the same proportional contraction, more extensive motions than the straight muscles can do.

FIRST, As one oblique muscle, so situate, is longer than a straight muscle, if each be shortened one third, or any other proportional part, it is evident, that the place of the insertion of the muscle will move through a greater space, when the oblique muscle acts. Thus, in the annexed figure, (T. 2. fig. 3.) if P, L represent two parallel lines, and A B represents an oblique and A C a straight muscle, it is plain, that when each is shortened one third, and that the place of the insertion is moved directly towards the place of the origin of the muscle, the motion occasioned by the oblique muscle will be proportionally as much greater than that produced by the straight muscle, as the hypotenuse, or line A B, is longer than the perpendicular line A C.

BUT next, let us suppose, (see T. 2. fig. 4.) that the point A cannot be drawn directly towards the point D or E, on account of the connections of the bones, such as, the ribs, which the parallel lines P A and D E represent; or suppose, that such bones, when moving, remain parallel to each other; or let us suppose, that two oblique muscles balance each other, so that their insertions, instead of being moved directly towards their origins, are moved in a diagonal line, between the two muscles.

THUS,

THUS, let P A and D E (T. 2. fig. 4.) be two parallel lines, and let A B and A C represent two straight muscles, and A D and A E two oblique muscles, it is plain, that when the two straight muscles have shortened themselves one third part of their length, their insertion A will be brought down to number 1. But when the oblique muscles A D and A E, by acting together, have brought the point A down to 1, and are in the situation of the dotted lines 1D and 1E, they cannot have lost more of their length than the length of the perpendicular A 1, which is shorter than the hypotenuse A b, or less than the third of the length of the oblique muscle. In fact, they have lost less of their length than A 1, because the two sides A 1 and 1E of the triangle A 1 E must be longer than the third side A E; and therefore oblique muscles can perform as great a degree of motion as straight muscles, without being shortened in the same proportion; or, which is the same thing, if they continue to act till they are shortened in the same proportion, the place of their insertion, A, will descend farther, or through a larger space.

I SHALL now proceed a step farther, and endeavour to demonstrate, that where two oblique muscles balance each other, the motion of their insertion is more extensive than can be produced by two straight muscles of the same length with the oblique muscles.

THUS, in T. 2. fig. 5. let A B and A C represent two straight muscles, and A D and A E two oblique muscles of the same length, and we shall suppose the length of each muscle to consist of any given number of inches or parts, suppose five parts, 1, 2, 3, &c. or I, II, III, &c. and when in action to be capable of shortening itself one fifth part or two fifth parts of its length. Let the two corresponding numbers 1 and I, or 2 and II, be joined by the straight lines 1 I, and 2 II, so as to form the isosceles triangles A 1 I, or A 2 II. When the two straight muscles

muscles have acted fully, or shortened themselves one-fifth of their length, the point A will descend to 1. But when the two oblique muscles have, by their action, brought the point A down to 1, they have not lost one-fifth of their length; for the dotted lines representing them must be longer than the lines I E or I D, because the angle 1 I E being equal to the two angles 1 I A and 1 A I of the isosceles triangle A 1 I, must be larger than a right angle, and therefore the side 1 E must be longer than the side I E; that is, the oblique muscles, after bringing the point A down to 1, have not lost one-fifth of their length; or if they continue to act till they have lost one-fifth of their length, they will bring the point A lower down than can be done by straight muscles, shortened in the same proportion.

To make this proposition still plainer, if possible, by calculation, I shall suppose the oblique and straight muscles in T. 2. fig. 6. to be each five parts or five inches in length; that the bases of the triangles B D and C D measure four inches; and that the perpendiculars, or altitudes of the triangles, measure three inches; and let it be supposed, that these muscles, in action, can be shortened one-fifth of their length, the straight muscles, on that supposition, can bring A down to 1 only: But it is evident, that the oblique muscles will not be shortened one-fifth of their length till the point A has descended to D, or to number 3; or the oblique muscles will, with the same degree of contraction, move the point A three times farther than can be done by straight muscles of the same length.

In the next place, we may easily demonstrate, that the extent of the motion produced by the co-operation of oblique muscles, increases with their greater degree of obliquity.

THUS, let us compare the extent of motion, produced by the pair of oblique muscles A D and A E, (T. 2. fig. 5.) with that

that of the still more oblique pair of muscles represented in the same figure by the lines $1D$ and $1E$. Let the muscles AD and AE be supposed to move the point A to number 1 , and let the muscles $1D$ and $1E$ be supposed to move number 1 to number 2 , or through a like space. It is evident, that in the triangles $1IE$ and $2II E$, the angles $1IE$ and $2II E$ are equal; but as the angle $2EI$ is larger than the angle $1EI$, the angle $II2E$ must be less than the angle $I1E$. Hence, as the sides of triangles are longer in proportion to the width of the opposite angles, the side IE will be longer in proportion to $1E$, than the side $II E$ is in proportion to $2E$. The muscular fibres, therefore, AD and AE , in bringing the point A down to number 1 , will lose more, in proportion of their length, than the more oblique fibres $1D$ and $1E$ will do in moving number 1 to number 2 .

To prove this by calculation, let us suppose the muscle to be still represented by the hypotenuse of a right angled triangle, five inches in length, and capable of shortening itself one inch, and that one of the other sides measures four inches, and that the third side measures three inches. But let the side 3 form the basis of the triangle, and the side 4 its perpendicular, as in T. 2. fig. 7.

IN this case, the square of the hypotenuse, when it has shortened itself one inch, will be 16 , from which deducting 9 , the square of the basis, the number 7 remains for the square of the perpendicular. But the square root of that number being more than $2\frac{1}{2}$, the oblique muscles, shortened one-fifth, cannot bring the point A down $1\frac{1}{2}$ inch, or to B , or cannot move the point A half so far as they were shewn to do, when the obliquity was greater, by making the basis 4 inches and the altitude 3 inches.

OR let us, on the other hand, increase the obliquity, as in T. 2. fig. 8. by supposing two right-angled triangles, so constructed

structed, as that their hypotenuses measure 13 inches, their bases 12, and altitude 5 inches, and that the hypotenuses represent two oblique muscles. It is plain, that when these have shortened themselves one inch, or one thirteenth part of their length, they will move the point A through a space of five inches, or five times farther than straight muscles of the same length, shortened in the same proportion, could do.

HENCE, as the obliquity of an oblique muscle is gradually increasing during its action, its force is diminishing ; while its effect, of producing extensive motion, is increasing. Thus, a muscle, representing the hypotenuse of a right-angled triangle, whose sides are to each other as the numbers 3, 4 and 5, and the altitude 3, by shortening itself half an inch, does not move its insertion one full inch ; but if it is shortened another half inch, its insertion is moved through a space of upwards of two inches more. When it begins to act, it has three-fifths of the strength of a straight muscle of the same size ; but when it acts again, after having moved its insertion the space of an inch, it has two-fifths only of the strength of the straight muscle.

To illustrate what I have been demonstrating, I used, after dissecting and demonstrating the recti muscles of the abdomen, to cut their ends off from the ossa pubis, and to apply them to the tops of the ossa ilia, so as to represent oblique muscles ; and from this I was led to make the remark, that if both the two external oblique, or the two internal oblique muscles, or all these, acted at once, the obliquity of the one balancing the obliquity of the other, the trunk of the body would be bended straight forwards, and that flexion made by them might be greater than that made by the recti muscles, which, at first sight seemed to be more suited to the purpose.

In like manner, I used to take out several of the ribs, with their intercostal muscles ; and after shewing the two layers of

these muscles laid obliquely, and decussating each other, I used to dissect some portions of the two layers, in such a manner as to represent oblique muscles, with their origins at a distance from each other, but their insertions meeting in a point, or with their insertions, as well as their origins, at a distance from each other.

IN the back part of the spine, I very particularly demonstrated the obliquity of many of the muscles, some of which are called semispinales, because one end of them only is fixed to the spinal processes, and the fibres passing obliquely, the other end of them is fixed to the transverse processes, or other parts of the neighbouring vertebræ.

IN the extremities, I not only carefully demonstrated the obliquity of the fleshy fibres, in the half and whole penniform muscles, but pointed out their connection with their tendinous aponeuroses, the different direction of the tendinous and fleshy fibres, and the uses of the aponeuroses and tendinous sheaths; and that, by means of the sheaths, there was so little difference between the length of the muscles in the bended and extended state of the member, that short fleshy fibres, especially when placed obliquely, could produce a very extensive motion.

BUT in treating of particular parts, I dwelt chiefly on the structure and effects of the intercostal muscles, as a variety of opinions concerning their operation has, in the course of the last hundred years, been proposed, and as no author had explained the reason of the obliquity of their fibres, nor of their being disposed in two layers of decussating fibres.

THAT their structure might be fully understood, I first laid bare the surface of the external intercostal muscles, and between the next two ribs, I cut off the external intercostals, to shew the internal, as in T. 3. fig. 4.

IN another space, I shewed a small bundle of the external intercostal, decussating a similar bundle of the internal intercostal,

costal, and forming a figure like the letter X, but in which the stroke representing the external muscle is more oblique than the other; for the internal intercostals are less oblique than the external. See T. 3. fig. 5.

THEN I dissected small bundles of the external and internal intercostals, with their origins at a distance from each other, but their insertions meeting in a point, in the rib above or in the rib below, so as to form triangles, of which the rib made the base, (see T. 3. fig. 6. and 7.); or I dissected them with their insertions, as well as their origins, at a distance from each other, as in T. 3. fig. 8.

IN the last place, I demonstrated a part of the structure which has not been sufficiently examined by authors; to wit, that the cartilages between the ribs and the sternum, with the exception of the cartilage of the first rib, are not fixed to the sternum in the same manner as to the ribs; for the rib, which is hollowed, receives the cartilage, and is so firmly united to it, that in a recent subject, they cannot be separated without lacerating the cartilage; but the inner part of the cartilage is tied by a capsular ligament to the edges of the pit in the sternum, and the concave part of the pit is connected by fine cellular threads only to the end of the cartilage, so that the cartilage and sternum may, after cutting the capsular ligament, be separated from each other without tearing the cartilaginous fibres. Hence, when the ribs are moved, the capsular ligament is twisted, and the end of the cartilage rolls upon the sternum. See T. 3. fig. 1, 2, 3. and 9.

AFTER fully explaining the structure, I endeavoured to prove, as Dr HALLER had done, but with some additional arguments, that both rows of intercostal muscles conspired to elevate the ribs, or that they were muscles of inspiration; and that, when the intercostal muscles alone acted, and the ribs were not forcibly kept down, they could have no other effect;

and that all the ribs in inspiration were moved upwards uniformly.

THE chief circumstances which prove beyond a doubt, that the two rows of intercostal muscles conspire in elevating the ribs, are,

1. THAT the first rib is so much fixed at both its ends as to be almost immovable, and its cartilage, instead of being connected to the sternum by a capsular ligament, or articulated with it in the same manner as the cartilages of the other ribs, grows as firmly to the sternum as to the rib. See T. 3. fig. 9.

2. THAT the second rib is more fixed than the third, and the third more fixed than the fourth, and so on downwards.

3. THAT as the ribs, from the first rib downwards, grow gradually longer, and describe portions of larger circles, we may observe, that in general, or when we examine a middle portion of the intercostal muscles, or a portion half-way between the sternum and vertebræ, the insertion of the lower end of the portion is at a greater distance from either end of the lower rib, or from a straight line drawn between the two ends of that rib, than its origin in the rib above is from the two ends of that rib, or from a straight line drawn between them. Hence, whether we consider the head of the rib, connected with the vertebræ as its centre of motion, or whether we consider the rib as moving upon a straight line or axis drawn between its two ends, it follows, that a muscle placed between two ribs acts with a longer lever upon the under rib than upon the upper one, and therefore must elevate the under rib. That the force of this argument might be more readily understood, I have laid leaden probes along each of the seven uppermost ribs of an adult subject, from the vertebræ to the sternum, and have represented their lengths and curvatures in T. IV. The crooked continued lines represent the lengths and curvatures of the different ribs and their cartilages. The straight dotted lines represent the distances

distances between their heads and the sternum. The continued perpendicular line represents the distance of the middle of each rib from a straight line drawn between its two ends. The numbers 1, 2, 3, 4, 5, 6, 7, express first, second, &c. ribs, of which the first is the shortest and innermost, and the seventh the longest and outermost. The other numbers annexed denote eighths of an inch.

4. To determine the effect of the contraction of any muscle, I apprehend, we need only to observe in the dead body what the situation is in which the muscle in question is relaxed. Applying this rule, we shall find, that the whole intercostal muscles, internal as well as external, are shortened when we elevate the ribs and place them in that situation in which we find they are in inspiration.

5. If the internal intercostal muscles had been intended for the depression of the ribs, we certainly should not have found them continued to the sternum, because their anterior ends are fixed above to the edge of the sternum, or so near to the insertion of the cartilage of the upper rib in the sternum, and their inferior ends are, in consequence of their obliquity, fixed to the under rib so much farther from the sternum, that they must act upon the under rib with more advantage of lever, or are intended for its elevation.

ON the other hand, if the internal intercostals had been intended for the depression of the ribs, we certainly should have found them continued backwards to the spine, because, from their obliquity, their under end would have been fixed to the vertebræ or nearer to the head of the rib, and their upper end at such a distance from it, that this portion of the muscle would have been better calculated than any other portion of it for the depression of the rib.

6. IN a few experiments which I made on living animals, soon after I began to study anatomy, and which I repeated afterwards, particularly in 1770, I saw plainly, as Dr HALLER had done,

done, that both rows of intercostal muscles were in action during inspiration.

AFTER proving, that both rows of intercostal muscles conspire in elevating the ribs, I used to point out the fallacy of the demonstrations, by which BAYLE, HAMBERGERUS, and others, have pretended to prove, that the internal intercostal muscles depress the ribs. The machine they describe as representing the ribs, vertebrae and sternum, resembles very exactly two wooden rulers A, B, kept parallel by two pieces of brass, C and D, such as are used for drawing parallel lines; and the two layers of the intercostal muscles are represented by the threads EF and HG, passing obliquely from the one ruler to the other, and decussating each other. See T. 2. fig. 9.

LET C, one of the pieces of brass, represent the vertebrae, and the other piece D the sternum. Let A represent the uppermost rib on the right side of the body, and B the second rib. Let EF represent the external, and HG the internal intercostal muscle.

THEN, let C, representing the immovable vertebrae, be held fast, and let EF be pulled or shortened, they tell us, that the second rib B must be more affected than the first, because the lower end of the muscle being at a greater distance from C than the upper end of it, the muscle will act upon the second rib with a longer lever, and therefore that the external intercostal muscles must elevate the rib.

BUT when the internal intercostal muscles, represented by HG, are shortened, they observe, that matters will be reversed; and as their origin in the first rib is farther from the vertebrae, or centre of motion, than their insertion in the second rib, that having a longer lever, they must serve to pull the first rib down.

ACCORDINGLY, the rulers, on pulling alternately the threads EF and HG, will be moved alternately upwards and downwards.

BUT

BUT to shew the fallacy of this, I need only to add to what has been before observed, that we can perform a full inspiration, without bringing the upper rib, or top of the sternum, upwards or nearer to our head; whereas the pretended demonstration rests entirely on the supposition, that all the ribs, not excepting the first and sternum, have a large play upwards and downwards alternately. Stop the play of the first rib, or suppose it to be fixed in its place, which is the fact, and the boasted demonstration is annihilated.

THE late opinion of SABATIER *, that both rows of intercostal muscles serve for expiration, and that the ribs are elevated by the scaleni and serrati postici superiores, which are fixed to a few only of the upper ribs, scarcely merits a comment. It is refuted by what is above mentioned, and by the want of the external intercostals near to the sternum, and of the internal near to the spine; for intercostals at those places would have served to depress the ribs more powerfully than in any other part of the thorax.

LET us now consider the purpose,

FIRST, Of the obliquity of the fibres in the intercostal muscles, and,

SECONDLY, Of their being disposed in two layers, the fibres of which decussate each other.

IT is evident, that the obliquity of the fibres here is not intended to increase their number, or the strength of the muscle, because the fibres would have been more numerous if they had passed directly from the one rib to the other, or had been inserted into the ribs at right angles.

I APPREHEND, therefore, that we are to explain the reasons of the structure in the following manner:

NATURE, in order to give protection to the heart and lungs, has formed the ribs as broad and flat as possible, or left no more space between them than is required for lodging muscles for

* See Anatom. T. 3. p. 465. 7. m..

for their motion in respiration. Consistently with this view; as the ribs are fixed at both ends, so that they cannot be moved backwards and forwards, but are confined to motion upwards and downwards, remaining nearly parallel to each other, oblique muscles are preferred to straight; for if the former can, as I have before demonstrated, perform more extensive motion than the latter, even where both are of the same length, they must have a still greater effect, where the two kinds of muscles are confined between the same parallels.

THUS, suppose the direct distance, or perpendicular drawn from one rib to another, to be represented by three parts, and that the intercostal muscle, in consequence of its obliquity, measures five such parts, and that each of these is capable, when in action, of shortening itself one-fifth part of its length; it appears from the demonstration, that the oblique muscle can move the rib through a space five times greater than the straight muscle can do.

ON accurate mensuration, I found the length of the intercostal muscle to be one inch and a half, the perpendicular line one inch, and the base about one and one-eighth inch. Hence, calculating on the supposition, that the muscular fibre, in action, shortens itself one-fifth of its length, it will be found, that the intercostal muscles, in consequence of their obliquity, produce a greater motion of the ribs than perpendicular muscles could have done, nearly in the proportion of 35 to 12.

THE only point remaining to be explained, is, why nature hath formed two layers of intercostal muscles decussating each other.

THE purpose of this, I apprehend, is to render the motion of the rib upwards as direct as possible, and to prevent it from being drawn or pressed forwards upon the sternum, or backwards upon the vertebræ, so much as, by its friction, to interrupt the freedom of its motion.



Tab. 1.

Fig. 1.

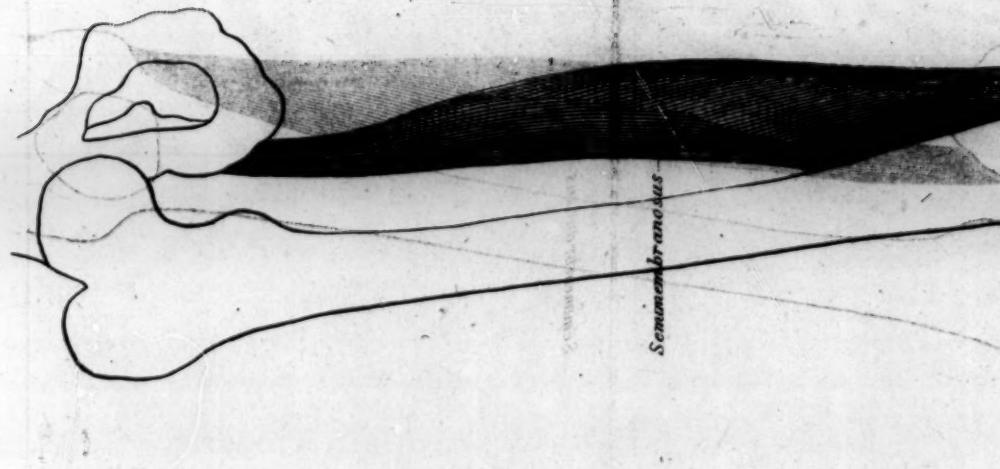


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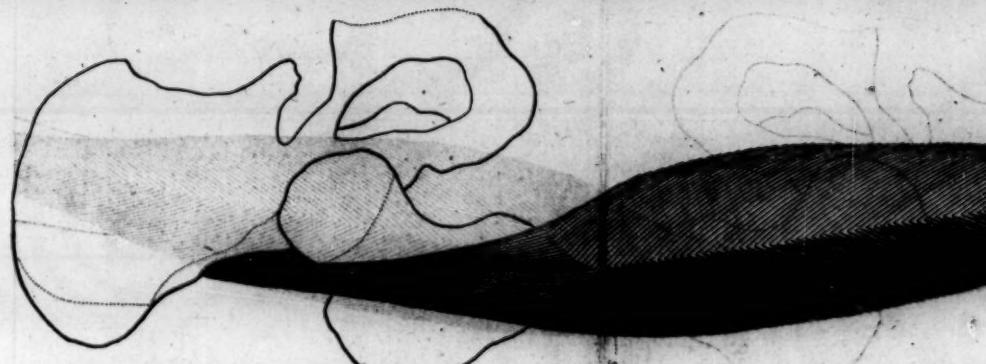
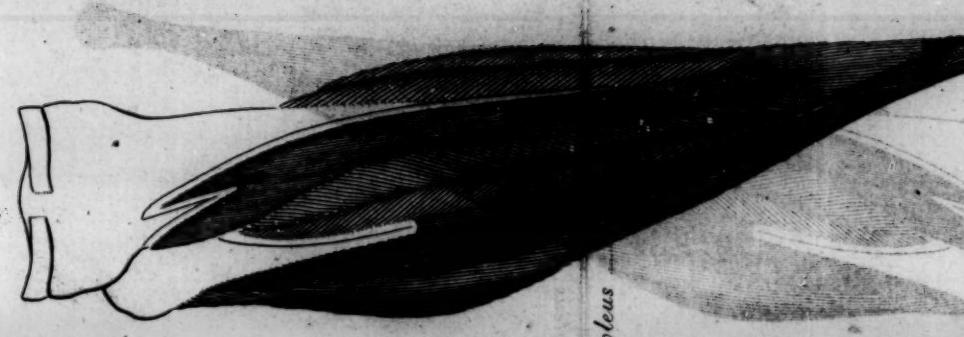
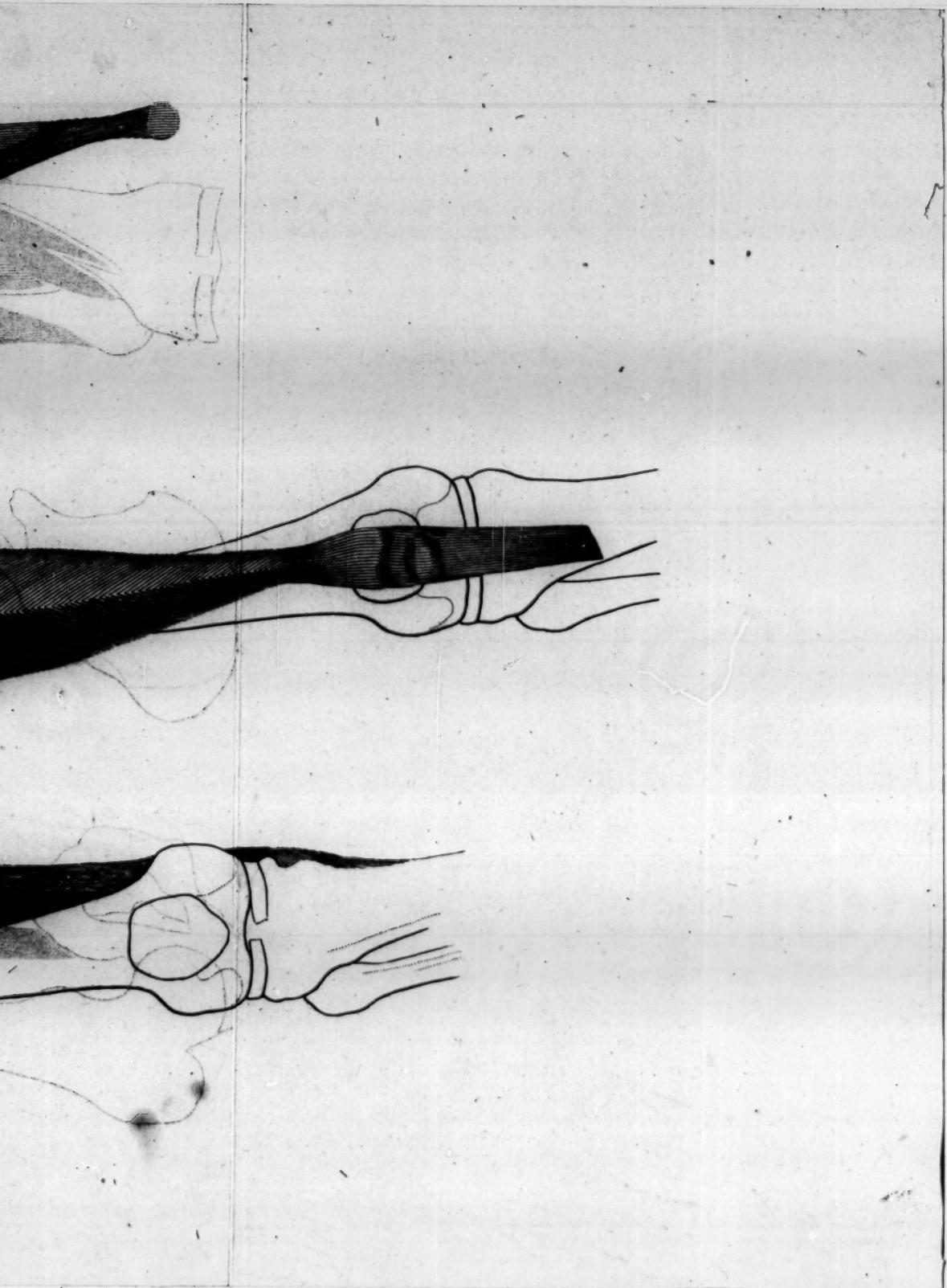


Fig. 3.





TAB.II

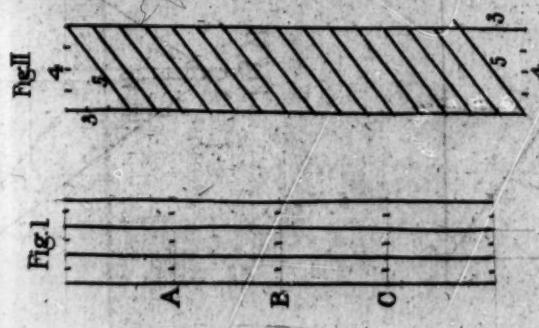


Fig.I

Fig.II.

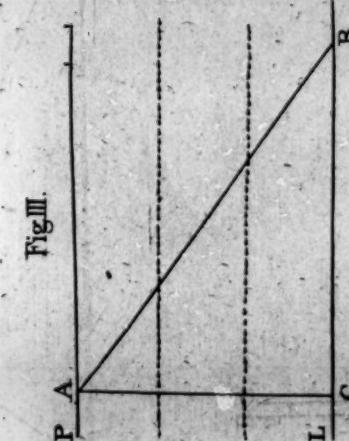


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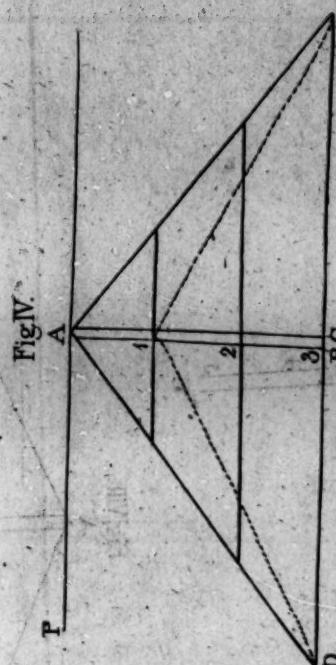


Fig.IV.

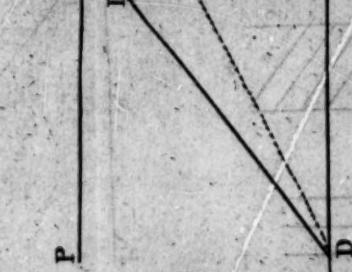


Fig.V.

Fig.VI.

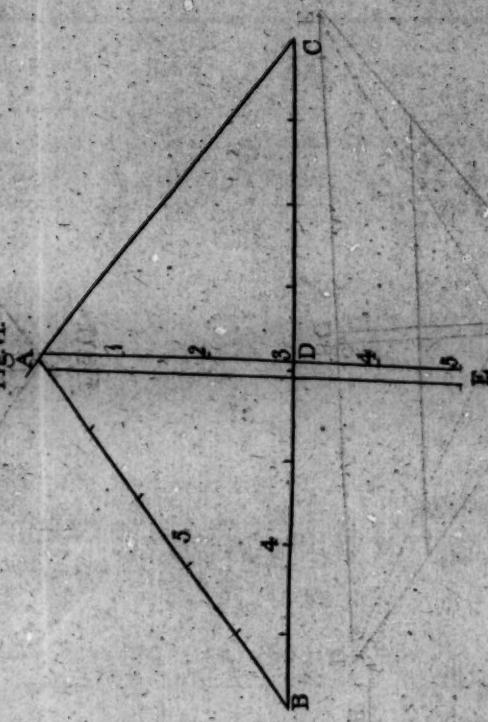


Fig.VII.

Fig. VI.

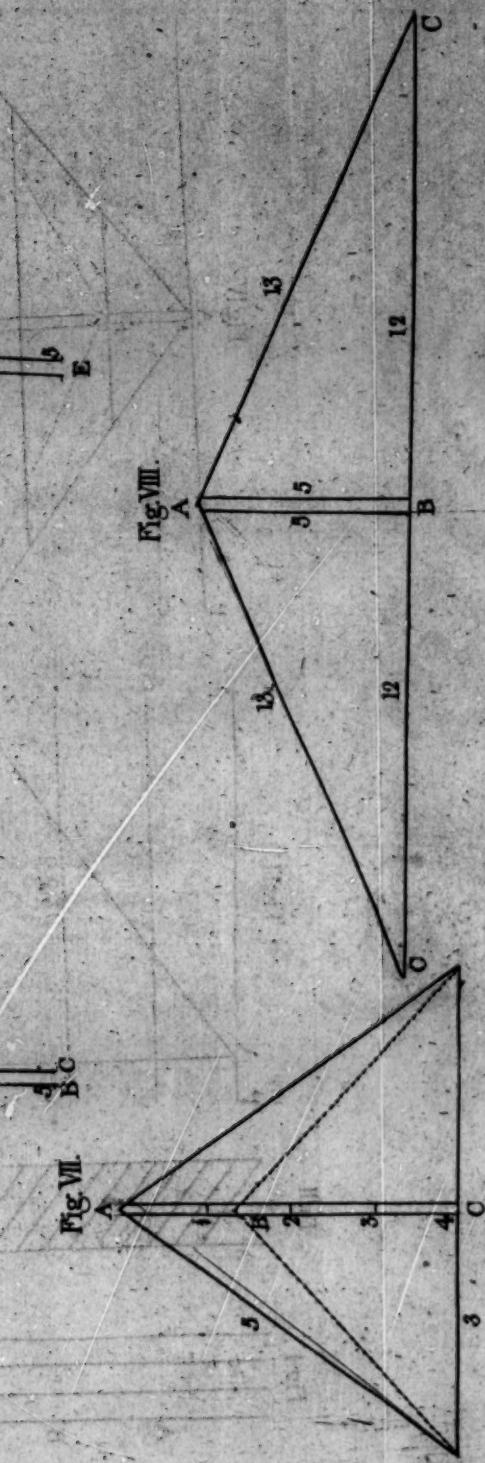


Fig. VII.

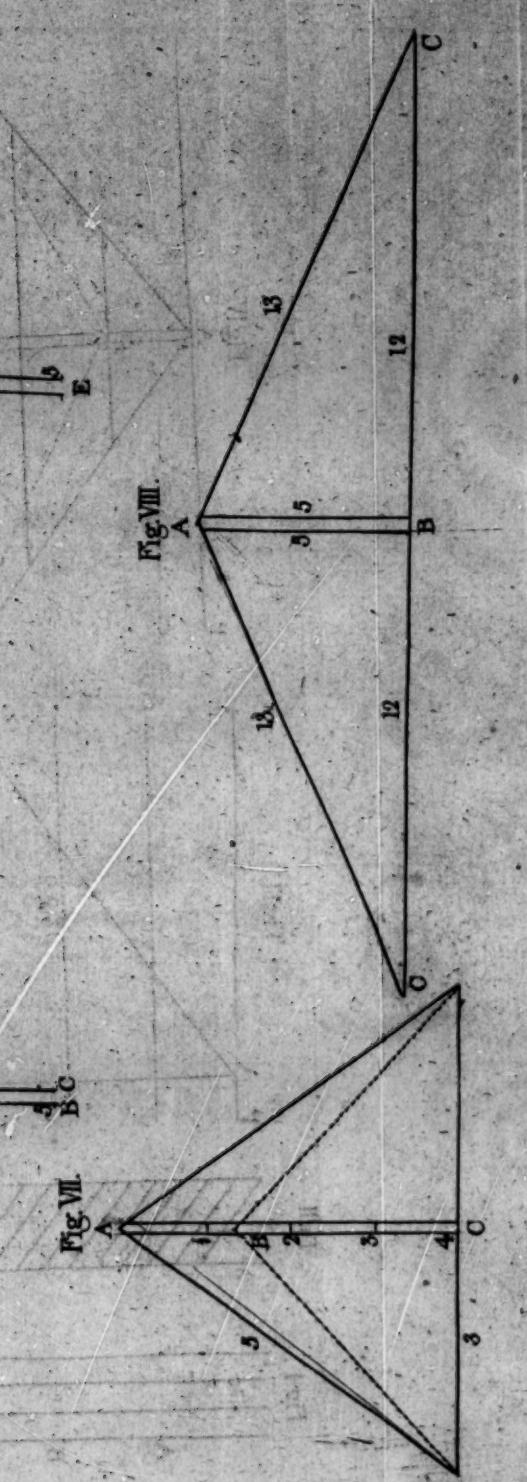


Fig. IX.

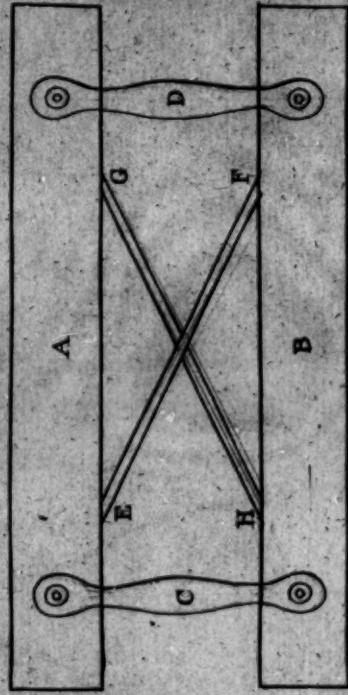


Fig. X.

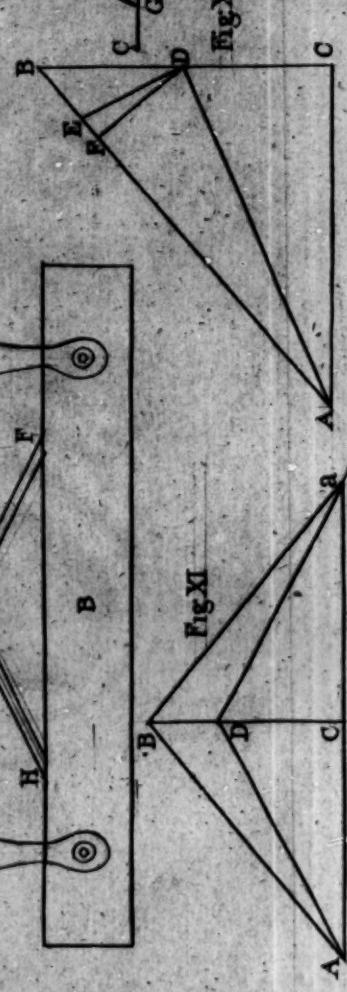


Fig. XII

LB. 200.

Tab. III.



Fig. 1.

Fig. 2.



Fig. 3.



Fig. 4.

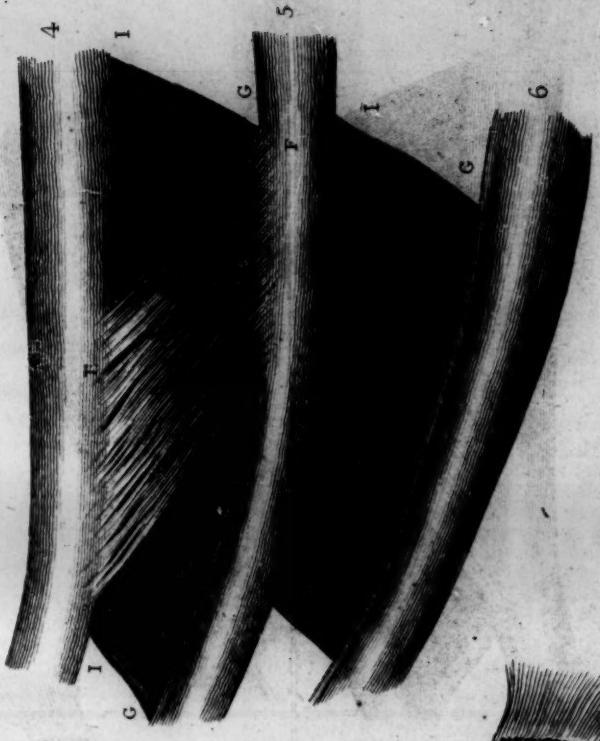


Fig. 5.



Fig. 6.

Fig. 6.

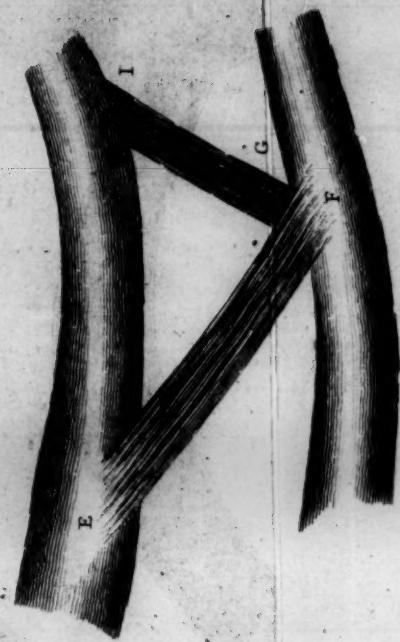
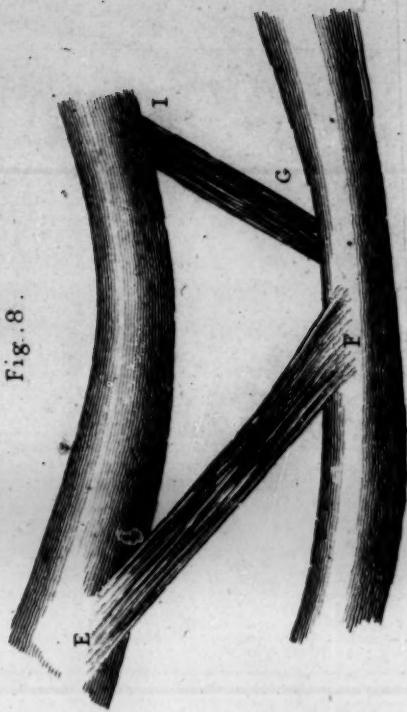


Fig. 8.



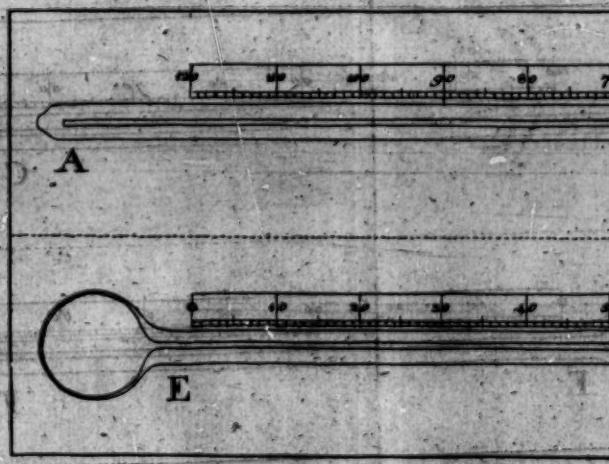
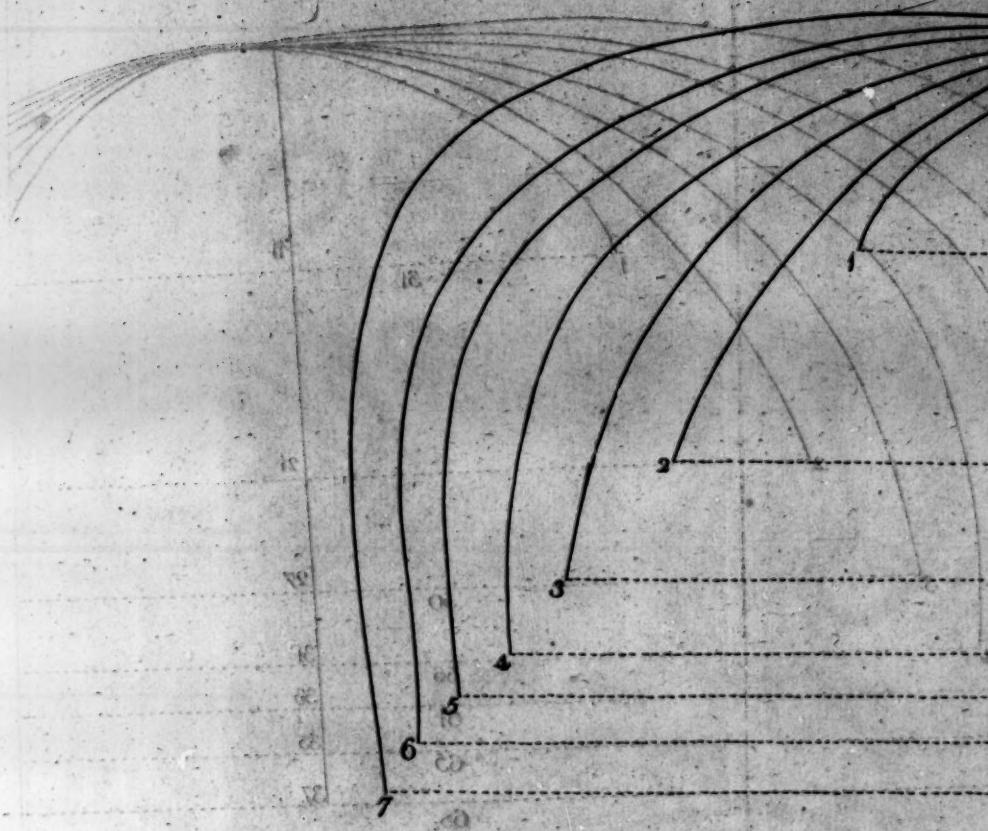
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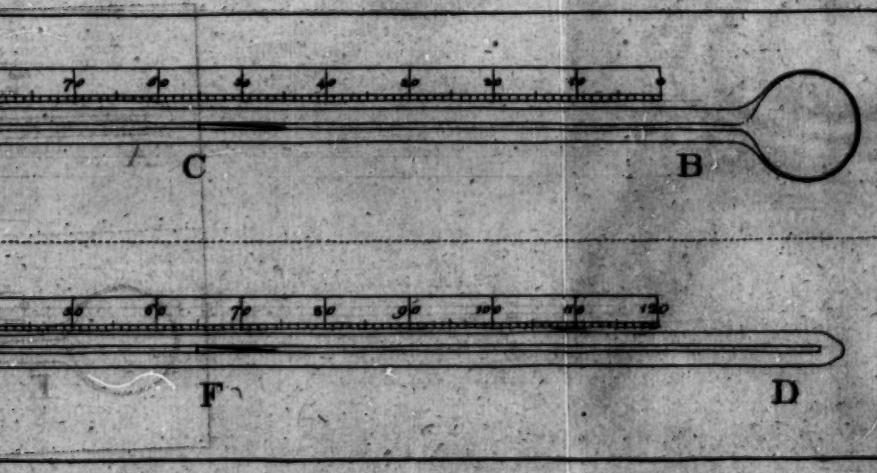
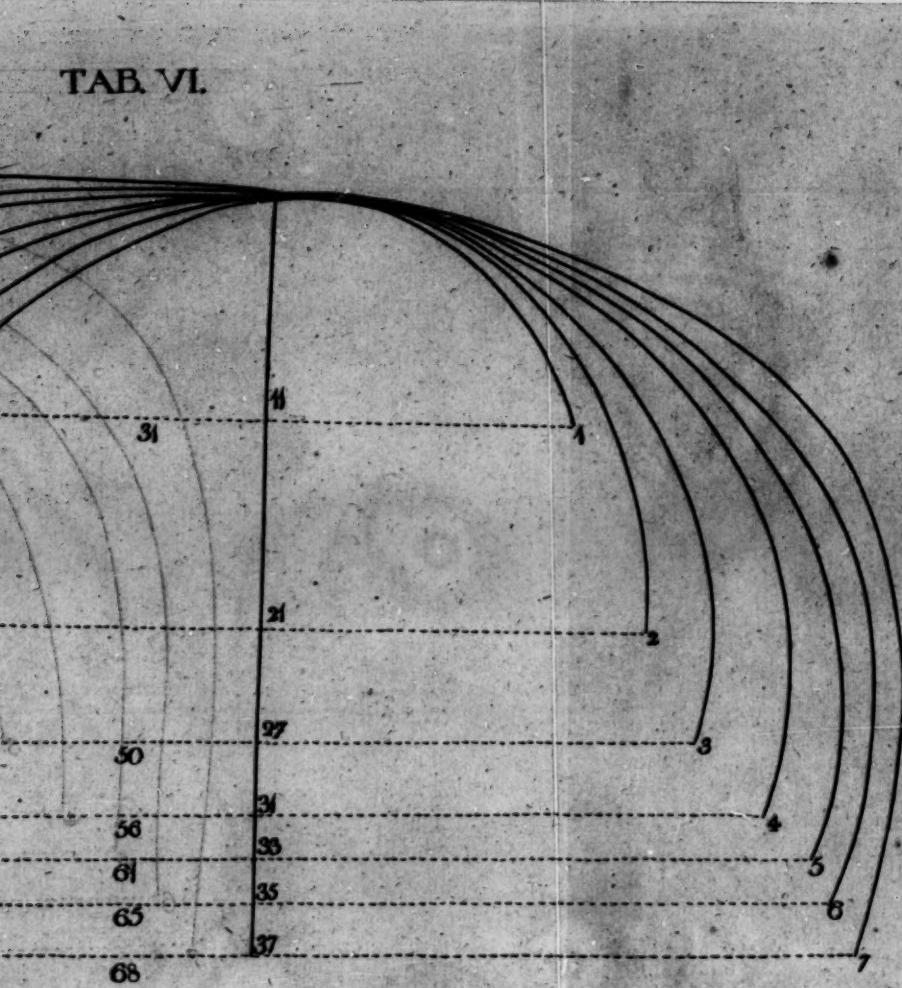
Fig. 7.

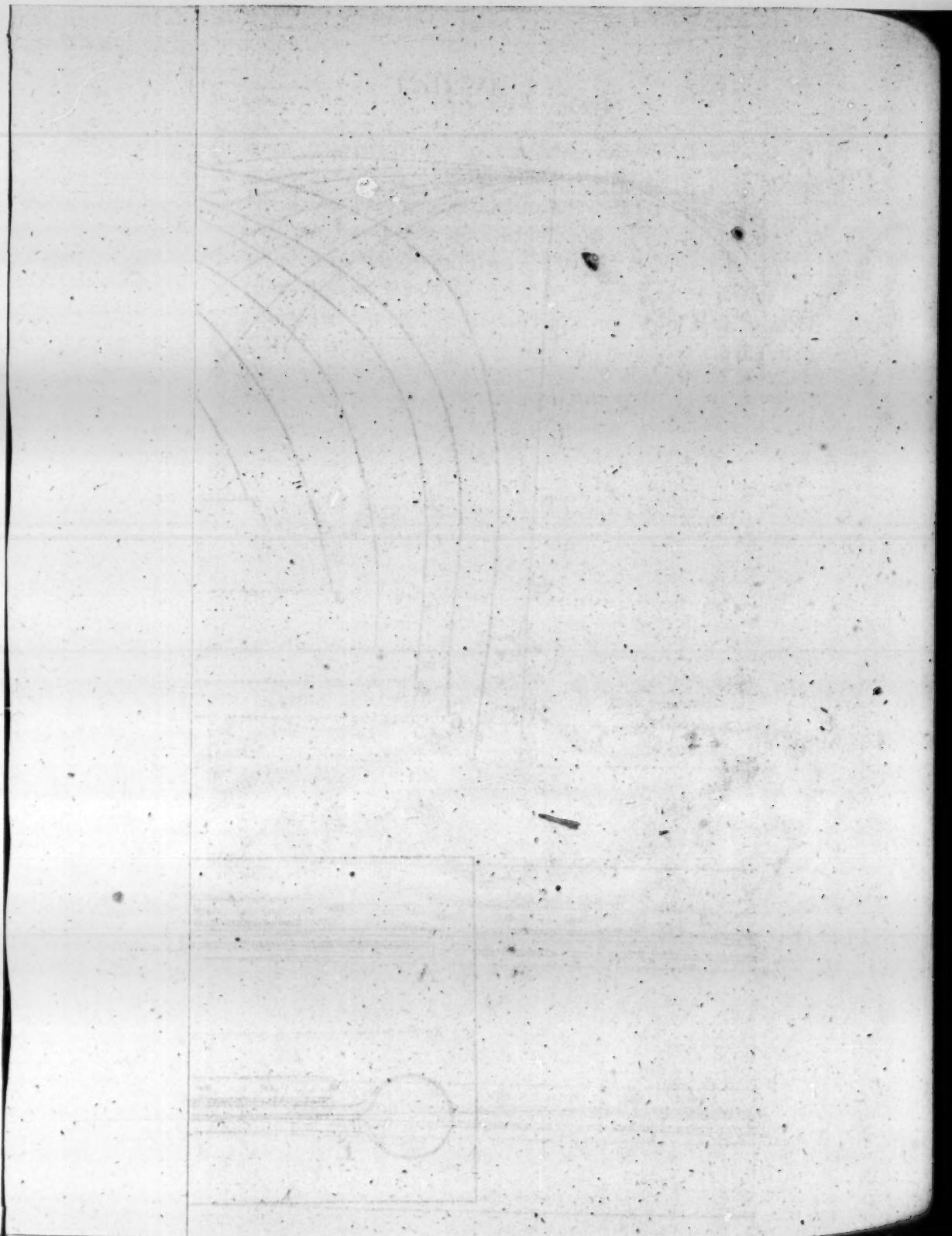


ANALYT



TAB. VI.





UPON the whole, by the obliquity of the intercostal muscles, the motion of the ribs is very much greater than could have been performed by straight muscles placed between them: At the same time, by their consisting of two layers, or two muscles decussating and balancing each other, the motion of the ribs, upwards and downwards, is as direct, and with as little friction, as if it had been performed by straight or perpendicular muscles.

VOL. III.**L I****XIV.**

~~Such interesting objects to the mind of a naturalist, and
such great interest to the mind of a man of science, as
the mosses of Kincardine and Flanders.~~

XIV. An Account of the PEAT-MOSESSES of Kincardine and Flanders in Perthshire. By the Reverend Mr CHRISTOPHER TAIT,
Minister of Kincardine.

[Read July 2. 1792.]

THE mosses of Kincardine and Flanders are situated in that extensive plain or *carse* which begins at Borrowstounness, on the south side of the Frith of Forth, and a little above Eastern Kincardine, on the north side. It stretches along both sides, first of the Frith, and afterwards of the river Forth, as far as Cardross, about twenty-two miles west of the point where it begins. The breadth of this plain, or carse, at Falkirk, where it is widest, is about seven miles, including what is occupied by the Frith. At Stirling it is contracted to three quarters of a mile, and the mean breadth of it, from that place to Cardross, is about three miles. The soil is a rich blue clay, beyond any depth that has been examined, excepting that a bed of gravel rises near to the surface for the space of a mile, betwixt Blair Drummond and Ochtertyre, and dips towards the Forth, at the rate of about one foot in the hundred. Almost the whole of this tract appears to the eye like a dead flat, the only eminences in it being those of Airth, Dunmore, Craigforth, and the hill of Drift, which are all inconsiderable, both as to extent and height. These eminences also contain the only rocks discovered

ed in the extent above mentioned, except that the Drift rock is continued across the river, and that another rock also crosses it, at what are called the cruives of Craigforth, and gives a considerable obstruction to the stream, so as to prevent the tide from flowing up farther. Throughout the rest of the carse, no stones whatever are found in the soil; but beds of sea-shells, particularly oyster-shells, appear in many places of it, as in ditches, where the earth has been dug to a certain depth, and in the banks of the Forth and its branches. A bed of this kind, of considerable thickness, is to be seen near the bridge of Goody, a small river that runs into the Forth; and another is to be seen in a bank, on the south side of the road between Polmouth and Borrowstounness. When the Forth encroaches upon its banks, it also discovers large logs of timber at various depths in the clay.

CONCERNING the river it may be necessary to remark, that the tide flows as far as the bed of rock near Craigforth, already mentioned, which is about 300 yards below the junction of the Teith and Forth. Above this point, the surface of the river is four feet and a half higher than the surface below, even at spring tides. The only other fall in the river from that place to Cardross, where the carse terminates, is one of three feet at the ford of Frew, about eight miles distant from the former, in a straight line.

IT will serve to give some idea of the flatness of this country to observe, that by a survey taken of the river, with a view to render it navigable, it was found, that a dam four feet in height, erected at the point of Craigforth, would increase the depth of the river more than three feet as far up as the ford of Frew; and that one of five feet in height, erected at Frew, would make a like addition to the depth of the river, as far as the ford of Cardross. The height therefore of the surface of the Forth, at the ford of Cardross, above the high water mark at the cruives of

Craigforth, is less than ten feet, and this on a distance of forty miles, measuring by the course of the river, or of eighteen miles, measuring in a straight line. The surface of the river is about twenty-one feet below the level of the clay-ground on each side of it; yet in floods, the country is often overflowed to a considerable extent.

A GREAT part of the surface of this country is covered by peat bogs, or mosses, as they are usually called. The first of these mosses, and the furthest east, is that of Kincardine, which lies in the angle between the Forth and the Teith, and reaches westward as far as Burnbank, after which the carse is clear of moss through its whole breadth for the space of two miles and a half. Beyond this, Moss-Flanders commences, and extends westward all the way to Cardross, occupying a large portion of the carse on both sides of the Forth. The moss of Kincardine, when measured twenty-five years ago, contained above 1800 acres; but the operations which will be described hereafter have now reduced it to about 1500.

BOTH these mosses are of the same nature, as are also some others less considerable, which lie in this tract, to wit, the mosses of Frosk, Dunmore and Kinnaird, which occupy a large share of the carse that lies at the head of the Frith, and also betwixt the rivers of Forth and Carron. The moss of Frosk begins about five miles to the south-east of that of Kincardine, and the moss of Kinnaird reaches within a mile and a half of the river Carron. The length of all these mosses, from the head of Moss-Flanders near Cardross, to the south-east point of the moss of Kinnaird, deducing the intervals that are clear of peat, is about fifteen miles, and the total of their contents is computed to exceed 9000 acres. The greatest height of the moss above the clay on which it lies is fourteen feet and a half.

THE surface of the peat-moss which thus rises above the level of the carse, when viewed at a little distance, seems wholly covered

covered with heath, but when examined more closely, is found to be made up only of small tufts of heath, intermixed with moss-plants, such as ling, cotton-grass, and in one spot with wild rosemary; these tufts being separated from each other by spaces of bog, which are quite soft, and have no plant whatever on their surface.

WHEN laid open, this moss is found to consist of an accumulation of the *debris* of the same plants, which are more or less advanced in putrefaction, according to the depth, and the degrees of humidity and compression. At the bottom of the moss, or at the surface of the clay on which it rests, is a stratum composed chiefly of bits of rotten wood, but with which is mingled sometimes a little black earth, and sometimes also bunches of heath, far more entire than those which are found nearer to the surface of the moss. Here also are innumerable trunks of trees, lying along close by their roots, which roots are still fixed in the clay, as in their natural state. The roots of the heath are also fixed in the clay, and appear to have been the production of the soil before the moss was superinduced over it.

IN the moss of Kincardine, is a considerable extent of what is called *flow-moss*, that is, flowing or fluid moss, the surface of which is smooth, and which, until lately drained, was so saturated with the water that was confined in it, either by the great extent of moss upon all sides, or by the greater height of some of the adjoining grounds, as to be almost literally in the state which its name indicates. The other parts of the moss have generally such a degree of solidity as fits them for being cut into peat, at least towards the bottom; for in the upper parts the plants are too little advanced in putrefaction, and too little compressed, to have the cohesion requisite to be formed into peat.

THE methods used for improving these mosses have been various. Sometimes, after the moss was so far drained by the common operation of making it into peat, as to bear cattle in dry weather,

weather, it was repeatedly plowed and burnt, so as to be converted into a manure for the clay that was under it*.

THIS could only be done where the moss was thin. Where it was too thick to be reclaimed in this manner, the people contented themselves with improving the surface, by plowing the ashes into it, or by laying upon it clay brought from the adjacent cultivated grounds. The progress, however, that was made in the cultivation of the moss by these methods was never very considerable; and therefore, for some time past, they have given place to that of floating off the whole body of the moss by water, except a stratum two or three inches thick in contact with the clay. The soil thus cleared of moss is excellent, and is found to let immediately for 15 s. per acre. This operation of floating is rendered practicable by the peculiar nature of this moss, which, as has been said, is superinduced upon the original soil, so that the clay under it is on a level with the adjoining cultivated grounds.

THIS method of cultivation is supposed to have been practised on the mosses betwixt the Forth and Carron about the beginning of the present century, where it is computed, that above 600 acres have been cleared with the water collected from the

moss

* THE people engaged in this work have their houses in the moss. These are at first sometimes built of sods supported by a frame of wood, laid on the surface of the moss; but as soon as any progress is made in clearing the ground, they are cut out of the moss itself. For that purpose, a drain is cut through the moss, and at least a foot deep into the clay, as far as the intended house is to reach; a space from two to six yards wide is then cleared all round it; and lastly the area of the house is also cleared, leaving a wall of moss on every side, about four feet and a half thick, at bottom, and three feet thick at top. The feet of the cupples which are to support the roof are inserted into this wall, but do not rest upon it, as they reach as low as the clay, from which they rise up, nearly perpendicularly, as far as the top of the wall. The gables are completed with sod or mud. As the moss-walls dry, and are consolidated, what was originally ten or twelve feet high, sinks down to the height of five or six feet.

moss alone, without the assistance of any stream from the higher grounds. The same method seems to have been followed in the mosses of Kincardine and Flanders about forty years ago, though with little effect, and without any general plan, till about the year 1770, when the late Lord KAMES, who was proprietor of 1500 acres of the moss of Kincardine, and a considerable portion of moss Flanders, adopted and greatly improved it. It is now in general use, and is conducted in the following manner.

A CHANNEL, about eighteen inches wide and two feet deep, is dug in the clay along the edge of the moss intended to be removed, through which a stream of water is conducted about a foot deep. The workman, with a wooden spade, then cuts away a layer of the moss along the edge of the channel to the breadth of about six feet, and throws it into the water, which, if the channel has a tolerable declivity, will serve to carry away as much moss as six men can throw into it. The moss being thus removed for the whole length of the channel, to the depth of about thirteen inches, and to the distance of about six feet, the operation is repeated upon the moss below, and so on, till there is left a stratum of moss, only six inches thick, upon the surface of the clay. This thin stratum of moss, being dried by the summer heat, is afterwards dug, or plowed, and burned, and when the ashes thus produced are plowed into the clay, the ground is thought to be sufficiently prepared for a crop of oats.

At the bottom of the moss when thus cleared, a multitude of the bodies and roots of trees are found, which leave no doubt, that the grounds now covered by the moss have been once occupied by a forest. Though it is not, I believe, unusual to meet with trees in mosses, yet they are rarely found in such abundance as in the present instance. For they are found here lying as thick upon the clay as they can be supposed to have grown upon it; and what is yet more singular,

the roots remain fixed in the clay in their natural state, corresponding, in size, and in species to the trees that lie by their sides.

THE trees are oak, birch, hazel, alder, willow, and in one place there are a few firs. Among these the oak abounds most, especially upon the west side of the moss, where forty large trees of this species were lately found lying by their roots, and as close to one another as they can be supposed to have grown. One of these oaks measures fifty feet, in length, and more than three feet in diameter, and three hundred and fourteen circles, or year's growths, were counted in one of the roots. In another part of the moss, an oak was found that measured four feet in diameter; and I am assured, that some years ago a root was discovered at Ross, on the south side of the moss, that was fifteen feet in diameter at the surface of the clay; and the tree, which was twenty-two feet in length, was four feet eight inches in diameter at the lower end, where it had been cut over, at the height of a yard from the ground.

THE oak is usually black, and the wood still sound, especially on the side of the tree that lies next the clay. It is fit for various purposes, and would probably be of much greater value, if the people into whose hands it falls had skill to dry it properly. As it is managed, it usually opens into various fissures, which disqualify it for being fawn into planks.

THE roots of the oak are all found fixed in the clay in their natural state, and usually rise above it to the height of about three feet. They are very little rotten, and it requires much labour to grub them up.

THE other kinds of trees are so much decayed, that fewer observations can be made upon them. Their roots are also fixed in the clay; but they generally rise not more than a foot and a half above its surface.

THE facts which have now been described will perhaps be found, upon examination, to point out the cause by which these trees were brought into their present situation, and also the time when that event must have taken place.

FOR, first, these facts are utterly inconsistent with the supposition that the trees have fallen through natural decay ; as in that case, they must have been broken over at different heights above the surface, and both the trunks and the roots must have been too far advanced in putrefaction, before the moss was formed over them, for any part of them to remain sound at this day.

THE same circumstances seem also irreconcileable with the supposition, that these forests have been blown down by the wind, as in that case also the trees must have been broken over at different heights, and must frequently have been torn up by the roots ; a single instance of either of which has not been seen by the author of these remarks. It is indeed said, that a few single roots, in different parts of the moss, have been observed, which seem to be torn up, and what is perhaps difficult to be explained, no trunk was found attached to them.

IT cannot be admitted as an argument in support of the preceding supposition, that the trees lie most frequently in the direction from south-west to north-east. For as the south-west wind is the prevailing and most violent wind in this country, the weight of the tops of the trees is generally turned from that quarter ; and by whatever cause they fall, they will therefore, in general, be directed towards the north-east.

THE most plausible solution therefore is, that the trees have been cut down. The height of the stumps, which is commonly about two feet and a half, favours this opinion, as, at that height, the diameter of a large tree is usually much less than it is nearer the ground, and as the cutter can better apply his

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strength at this than at a greater height. The soundness of the roots and trunks seems also inexplicable on any other supposition.

MARKS of an ax, not exceeding two inches and a half in breadth, are sometimes discernible on the lower ends of these trees. The small breadth of the ax, and the length of the time that the trees doubtless remained exposed, before they were covered with the moss, seems sufficiently to account for these marks not having been more frequently discovered.

BUT it will be asked, what reason can be assigned for undertaking a work of so great labour as the cutting down of such extensive forests must have been? The value of the timber was evidently not the motive of this work, otherwise the trees would not have been left behind. Neither was the clearing of the ground the object that was in view, since, after all this labour, the ground remained as much incumbered as before. If, however, we recollect the history of Britain from the reign of DOMITIAN to the accession of CARACALLA, and consider the local situation of the mosses, we will find good reasons for ascribing the destruction of the forests in question to the Romans.

IT is well known, that from the time when JULIUS CESAR first invaded this island to the decline of the Roman power, the Britons, unable to contend with the arms and discipline of the legions in pitched battles, or in the open country, were forced to take shelter in their woods and morasses, from which they annoyed the Romans by their incursions. The Roman Generals, therefore, from the time of AGRICOLA at least, employed not only their own soldiers, but also many of the provinciated Britons, in depriving the free Britons of their places of refuge, by cutting down the woods, or, at least, making great openings in them, and by draining the morasses, or making roads through them. These seem to be the servile labours which GALGACUS,

in his speech before the battle with AGRICOLA, warns the Caledonians of, as awaiting the vanquished. *Corpora ipsa ac manus, sylvis ac paludibus emuniendis, inter verbera ac contumelias conterunt**.

IN like manner, SEVERUS is said to have employed a great part of his troops, not only in building the wall which bears his name, but in cutting down the woods, draining the marshes, and throwing bridges over the rivers which obstructed his march into the northern parts of Britain †. But though in that march he must probably have passed over the very grounds now occupied by the mosses of Kincardine and Frosk, I am inclined to believe, that the destruction of the forests upon the side of the Forth, is rather to be attributed to his predecessors, who aimed at making the wall between the Friths of Forth and Clyde, the limits of their empire, than to SEVERUS himself, who withdrew his troops from the country betwixt the two walls, and either strengthened ADRIAN's wall, from the Tyne to the Solway Frith, or built another nearly in the same direction.

THE Romans indeed must have found themselves more incommoded by the forests in question than by any other almost in the island; both because of their vicinity to the Roman province, and because the only roads by which the Romans could penetrate into the country possessed by the Caledonians were through the carse, and across the grounds between the mosses of Frosk and Kincardine.

THE moss of Kinnaird, which was no doubt formerly united to that of Frosk, is only a mile and a half distant from

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the

* TACITUS in Vit. AGRIC. cap. 31.

† Σεβῆρος δῖαι την Καληδονίαν, ἀμύντα προσγειώσα εχει, τας τε ὄλκες τεμάνει, τας τε ἐπι χαμηλώνει,
και τους ποταμους ξυγόνει. DIO. CASS. Lib. lxxvi. cap. 13. The works here enumerated were attended with such difficulty, that though, according to the same historian, SEVERUS was never met by the British army in the field, he lost fifty thousand men in the course of this expedition. *Ibid.*

the river of Carron, which river, where it enters the carse, and ceases to be fordable, seems to have been the boundary of the Roman province *, and the moss of Kincardine is only twelve miles distant from the station at Camelon. Forests, therefore, in either of these places would have afforded very convenient refuge to the Caledonians, whether they were making incursions into the Roman province, or harassing the Roman armies in their expeditions towards the north.

BESIDES, that a people, more civilized than the ancient Caledonians, must have been in this country before the moss of Kincardine existed, is completely established by the discovery of a road on the surface of the clay at the bottom of that moss, after the peat, to the depth of eight feet, had been removed. The part of this road already discovered is about seventy yards long; the breadth of it is four yards, and it is constructed of trees, measuring from nine to twelve inches in diameter, laid in the direction of the road. Across these have been laid other trees about half their size, and the whole has been covered with brushwood. The depth of the materials varies in conformity to the nature of the soil; the trees, which are laid lengthwise, being generally on the surface of the clay, but in the lowest and wettest parts, they are sunk about two feet under the surface.

THIS road lies across a piece of ground lower than the adjacent grounds, and its direction is from the Forth across the moss, where it is narrowest, towards a road, supposed to be Roman,

* THAT the river Carron was the boundary of the Roman province is rendered probable by the situation of Arthur's Oven, as it was called, which is supposed to have been a temple dedicated to TERMINUS, and erected near the Roman frontier. It stood on the west side of the river Carron, or between that river and Kinnaird. There is also a passage in HERODIAN that favours the same opinion. That historian mentions the army of SEVERUS passing τα περιβολεμένα οἰκίατά τι καὶ χώματα της Ρωμαϊκής αγχούς. He adds, that on this frontier the Barbarians easily made their escape, and concealed themselves in the thickets and marshes. HEROD. Lib. iii. cap. 48.

man, that passes between the moss and the river Teith. The vestiges of this last road have been traced, from about four miles north-west of the bridge of Drift, where formerly there was a ford, across the river, south-east by Torwood and Larbert, to Camelon on the wall. This road is laid about a foot deep with gravel, under which, in some places, is also a layer of stones, and it appears to have been about twenty feet wide, though, by the land having been under tillage, its breadth cannot be exactly ascertained. The direction of it, after it crosses the Forth at Drift, is in a line that points north-west to the pass of Leny, the chief avenue to the Highlands on this side, and through which the military road to Fort William is now actually conducted. It is therefore considered, with great probability, as having been originally designed for the use of the troops employed to repel the incursions made by the Caledonians, from the mountains, into the Roman province. At the same time, it may have been connected with the other roads that stretched more directly toward the north, by Dumblane and the well known station of Ardoch. It can scarcely be doubted, that it also communicated with the road in the moss, and that this last is to be reckoned a part of the military works of the Romans.

ON the whole, therefore, the conclusions to which we are thus necessarily led appear to be these: That before the time of AGRICOLA, the first of the Roman Generals who attempted to secure the northern frontier of the province by a regular chain of posts *, the greater part of the level country on the banks of the Forth was occupied by extensive forests: That about this period, or soon afterwards, a great part of those

rests,

* THE chain of posts between the Forth and Clyde is mentioned by TACITUS, *Vit. Agric.* cap. 23. as the work of AGRICOLA's fourth campaign, which coincides with the year 81 of our era. See HORSELEY'S *Britan.* Book i. chap. 3. It was about fifty years afterwards that the wall of ANTONINUS was built, nearly in the same line. The age of the moss cannot therefore be estimated at much less than 1700 years.

rests, being at no great distance from the above frontier, were cut down by the Romans for the purpose of depriving the natives of the fastnesses and places of strength from which they were continually making incursions into the province; and that from the trees thus cut down, and suffered to rot upon those low and marshy grounds, originated the vast body of peat-moss which covers them at the present time. The production of peat-moss from the decay of forests, is not a *postulatum* that will be supposed subject to any difficulty. It is a principle admitted by naturalists, on the ground of actual observation*, with respect at least to countries in high latitudes, and serves to explain many appearances in other parts of this island, which have a great resemblance to those that have now been described †.

* See Lord CROMARTY's paper on Peat-moss, Phil. Trans. vol. xxvii. p. 296.

† See an Account of Hatfield Chace near Doncaster, Phil. Trans. vol. xxii. p. 980. It may be proper to observe, that the mosses of Kincardine, &c. being placed above the level of the adjacent plain, are of the kind that might be expected to break out and overspread the lower grounds, which however they are not known to have done, while they remained in their natural state. They do not indeed abound very much in water, insomuch that the floating off of the peat, when it is carried to such an extent as it is now, requires an artificial supply of water. This supply is accordingly procured at present by an engine which Mr DRUMMOND has caused to be erected for raising water from the Teith, and which is one of the most material improvements that has been made in the husbandry of the moss.

BUT though there is no memory of the moss having flowed while it remained in its natural state, on the 21st March 1792, it burst out on the west side, near the southermost cottage, to the height of its side-wall, covering fifty-six yards in breadth, and about the extent of an acre of ground that had been cleared, and early in the morning of the same day of 1793, (since the first communication of this paper), it was discovered to have flowed again, and to have reached the northermost cottage of the same line of houses. The inhabitants escaped by a window on the opposite side of the house. The moss afterwards bore down the side-walls of the house that were built of stone, and continued to flow slowly forward,

eight feet in depth at the middle, and 1200 feet in breadth, until nine o'clock in the morning of the 23d, when it had advanced 600 feet, and covered twelve acres of ground that had been cleared. It would undoubtedly have flowed much farther, had not a great number of men been employed night and day, in giving vent to the water mixed with the moss that had flowed, and in intercepting that which continued to discharge itself from the main body of moss.

END OF PAPERS OF THE PHYSICAL CLASS.

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II.

PAPERS OF THE LITERARY CLASS.

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СВЯТОЕ ПРЕДСКАЗАНИЕ МАРТЫНУ

II.

PAPERS OF THE LITERARY CLASS.

L TABLEAU de la PLAINE de TROYE : Accompagné d'une CARTE,
levée géométriquement, en 1785 et 1786. Par M. CHEVALIER,
des Académies de MËTZ, de CASSEL, de ROME, et de la
Société Royale d'EDINBOURG.

[Read by the Author, Feb. 21. 28. and March 21. 1791.]

CHAPITRE I.

Voyage de Venise au Cap Baba, sur la côte d'Asie.

LA suite du voyage d'Italie, j'attendais à Venise une occasion favorable pour entreprendre celui de la Grèce. Le Chevalier ZULIANI, nommé Ambassadeur de la République auprès de la Porte Ottomane, alloit incessamment partir pour sa destination ; je lui demandai une place sur son vaisseau, et je fus assez heureux pour l'obtenir. Cet Ambassadeur, qui réunit à toutes les qualités d'un habile négociateur, le goût le plus décidé pour les arts et pour les sciences, avoit aussi reçu dans son vaisseau le célèbre Docteur SPALLANZANI, l'un des plus ingénieux naturalistes de ce siècle, que l'Empereur JOSEPH II: envoyoit

dans le Levant, pour enrichir la science de la nature de découvertes nouvelles.

JE ne tardai pas à appercevoir dans mes respectables compagnons de voyage, parmi les brillantes qualités qui les distinguent, la même passion que j'avois moi-même pour les monumens de l'antiquité ; bientôt nous nous fumes entendus, et partout où le vaisseau relachoit, il sembloit qu'un instinct commun rapprochât nos pensées et dictât nos projets.

APRÈS avoir parcouru ensemble les côtes et les îles du Golphe Adriatique ; après avoir visité les antiquités de Pola, les montagnes de la Chimère, les îles d'Ithaque, de Corfou, de Céphalonie, de Zanthe, et de Cythère, nous abordâmes, après une affreuse tempête, au promontoire de *Sunium*, où l'on voit encore les imposans débris d'un temple de *Minerve Suniade* *. Je débarquai là, et par un de ces accidents qui n'arrivent que trop souvent aux voyageurs, que l'excès de leur curiosité emporte loin du port, lorsque des vents impérieux forcent le vaisseau de mettre à la voile, je fus réduit à la douce nécessité de voir Athènes et une partie du continent de la Grèce.

EN quittant l'Attique, je m'embarquois au port Pirée dans l'intention d'aller directement à l'embouchure de l'Hellespont, pour y chercher la *Plaine de Troye*, que j'avois fixée, même avant mon départ de l'Italie, comme le principal objet de mes recherches ; mais les vents contraires, (je devrois plutôt les appeler favorables) me jetterent successivement dans les plus belles îles de l'Archipel, et enfin dans celle de Mitylène, d'où j'atteignis le *Cap Baba*, que les anciens appelloient *Lectos*.

ME trouvant sur la côte d'Asie, dans un point très éloigné de l'Hellespont, je résolus de la suivre avec l'attention la plus scrupuleuse, et d'observer surtout les plaines et les fleuves qui se rencontreroient sur ma route ; c'étoit le moyen le plus sûr de découvrir la situation de la plaine de Troye, et les momunens mentionnés

* Voir Les Ruines des plus beaux monumens de la Grèce, par M. LE ROY : et CHANDLER's Travels in Asia Minor, p. 9.

mentionnés dans les poèmes d'HOMÈRE. Les différentes épreuves que j'avois faites de son exactitude dans les lieux que je venois de parcourir, m'autorisoint à penser qu'il n'en auroit pas manqué dans la description de la Troade ; et j'étois d'avance convaincu que je devois la trouver telle qu'il l'a dépeinte dans ses vers.

IL ne me sera pas difficile, me disois-je à moi-même, de trouver ces deux promontoires qui terminoient le camp des Grècs, et où étoient les postes d'AJAX et d'ACHILLE *. Parmi les vallées voisines de la plaine de Troye, je démèlerai celle de Thymbra, où les alliés des Troyens étoient campés †. Je distinguerai le cours impétueux du violent *Simois* ‡, et les eaux limpides du divin *Scamandre* ||, dont les bords sont couverts de fleurs. Elles ne doivent pas être perdues les sources de ce divin fleuve que le Poète a designées par des caractères aussi particuliers et aussi saillans §. Pourquoi ne resteroit-il pas quelques traces des tombeaux de ces guerriers fameux, qui devoient être l'objet du culte des navigateurs dans la posterité la plus reculée ? ** Ces agréables collines qui s'étendoient le long des bords du Simoïs n'auront pas perdu, sans doute, leur position ni leurs charmes ††. Peut-être même pourrai-je retrouver encore l'emplacement de l'ancienne Troye, le tombeau du vieux *ÆSYTES* ‡‡, celui d'*ILUS* |||, et cette *colline des figuiers* qui donnoit tant d'inquiétudes à *ANDROMAQUE* §§.

Vous aurez peine à croire, Messieurs, que ce beau songe se soit réalisé ; et je craindrois, avec raison, de passer à vos yeux pour un enthoufiaste et un visionnaire, si la plûpart des monumens que je viens de citer, n'avoient pas été aumoins remarqués, si non exactement observés, par des voyageurs dont vous respectez les noms ; et s'ils n'étoient pas encore exposés à la vue de ceux qui prendront dans la suite la peine de vérifier leur position au moyen de la carte topographique que j'ai dressée.

ENIVRÉ

* Iliad. viii. 222. xi. 5.

** Iliad. vii. 86. xxiii. 45. 255. Od. xxiv. 80.

† Ib. x. 430.

†† Iliad. xx. 53. 150.

‡ Ib. xii. 21, 22. xxi. 307.

‡‡ Ib. iii. 793.

|| Ib. vii. 329. xii. 21. ii. 467. v. 36.

|| | Ib. x. 415. xi. 166. 371. xxiv. 349.

§ Ib. xxii. 147.

§§ Ib. vi. 433. xi. 167. xxii. 145.

ENIVRÉ donc d'avance d'une foule de jouissances futures, alors très incertaines, je pars du Cap Lectos accompagné d'un Janissaire, qui ne manqua pas de chercher à m'effrayer par des dangers imaginaires, afin d'être plus largement récompensé pour les avoir courus avec moi, et avoir montré la résolution de m'en garantir.

APRÈS avoir observé sur ma route les débris d'un temple, et les salines de Tragésée, dont l'abondance, suivant STRABON*, dependoit autrefois de certains vents périodiques, ou érétiens, qui y apportoient le sel tout formé, j'arrive sur les ruines d'*Alexandria Troas*, que les Turcs appellent *Eski-Stamboul*, la vieille *Constantinople*, comme s'ils la croyoient digne par ses restes immenses d'avoir été l'ancienne capitale de leur Empire.

C H A P. II.

Description d'Alexandria Troas et de ses Ruines.

ALEXANDRE le Grand, dit le Dr CHANDLER, au lieu de marquer ses progrès par des ravages et des vexations, comme le commun des conquérants, laissoit sagement des monumens durables de ses victoires dans tous les lieux qu'il subjuguoit. Il batissoit des villes ; il élevoit des temples ; et comme le séjour qu'il faisoit dans chaque ville n'étoit pas de longue durée, il laissoit à des ministres éclairés, et dignes de sa confiance, le soin d'exécuter ses vastes desseins.

ALEXANDRIA Troas fut une des dix huit villes qui portoient son nom ; elle fut commencé par ANTIGONUS, et prit d'abord le nom d'*Antigonia* ; mais LYSIMAQUE, à qui elle échut en partage comme patrimoine d'ALEXANDRE, lui donna le nom de ce conquérant.

DANS la guerre d'ANTIOCHUS elle se distingua par sa fidélité pour les Romains, qui, en récompense, lui accordèrent

" tous.

* Lib. xiii. p. 902. edit. Amst. 1707.

" tous les priviléges dont jouissoient les villes d'Italie. AUGUSTE y envoya une colonie qui en augmenta la population, et elle devint la plus considérable de toutes les villes qui se trouvoient entre le Cap Sigée et le Cap Lectos *."

SUETONE raconte que CESAR, par respect pour la contrée qui donna naissance à ses ayeux, avoit formé le projet d'y transporter les richesses de l'Empire †. On croit qu'AUGUSTE en avoit été tenté lui même, mais que MÉCÈNE, AGRIPPA, et les principaux courtisans de ce prince, connaissant l'influence de la poësie sur son cœur, engagerent HORACE à lui addresser cette ode dans laquelle il introduit avec un art et une delicateſſe admirables, la Déeffe JUNON menaçant les Romains de toute fa colère s'ils entreprenoient de relever les murailles de Troye :

*Sed bellicosis fata Quiritibus
Hac lege dico, ne nimium pii,
Rebusque fidentes, avitæ
Tecta velint reparare Trojæ ‡.*

Il est possible que CESAR ait eu des raisons de se dégouter de séjour de Rome, et qu'il lui soit venu dans la pensée de s'en éloigner ; mais on ne peut guères supposer qu'AUGUSTE, adoré de ses sujets, ait put nourrir un instant dans son ame le projet de s'éloigner d'eux, et qu'après avoir pacifié l'univers, il ait préféré l'obscure ville d'Alexandrie, au brillant séjour de Rome.

LE premier objet qu'on apperçoit en arrivant à Eski-Stamboul du Cap Baba, sont les bains chauds, que les Turcs appellent *Lidja-Hamar*. Ils sont entretenus par deux sources dont la chaleur est différente, quoiqu'elles ne soient pas à trente pas l'une de l'autre. Le thermometre de FAHRENHEIT, qui étoit à l'ombre à 82 degrés, est monté dans l'une à 113, et à 110 dans l'autre.

UNE

* Travels in Asia Minor, chap. ix. STRABO, lib. xiii. p. 887. edit. Amst. 1707.

† SUETON. c. 79.

‡ Lib. iii. Od. 3.

UNE tradition conservée parmi les Turcs qui habitent les villages voisins, nous apprend, que dans le siècle dernier ces sources tarirent à la suite d'un tremblement de terre, et qu'elles ne reparurent que dix ans après. Les murailles qui les entourent sont remplis de débris de statues ; parmi lesquelles j'ai reconnu celle de HERCULE jeune, et d'une femme dont la draperie m'a paru du plus beau stile.

LA colline sur le penchant de laquelle sont situés les bains de *Lidja*, est couverte de tombeaux. En la parcourant jusqu'au bord de la mer, on trouve à chaque pas des Turcs occupés à briser des Sarcophages de marbre blanc, ornés de bas-reliefs et d'inscriptions, pour en faire des boulets, ou des décorations à leur propres sépultures. Depuis long tems les ruines d'*Alexandria Troas* fournissent de boulets les chateaux des Dardanelles, et la source est loin d'être épuisée.

CELUI de tous les monumens situés au dehors de la ville, que la main du tems semble avoir le plus respecté, a la forme d'une colonne brisée, de dix pieds de diamètre ; il se trouve près des ruines d'un aqueduc, qui s'étend encore fort loin vers l'embouchure de l'Hellespont, et qui par sa magnificence, et sa solidité, rappelle le généreux patriotisme de celui qui l'a bati.

HERODES ATTICUS, gouverneur des villes libres d'Asie, voyant celle d'Alexandrie condamnée à s'abreuver de l'eau corrompue des citernes et des puits, écrivit à ADRIEN pour le supplier de ne pas permettre q'une ville maritime aussi intéressante fut privée d'un secours que de simples villages de l'Asie avoient obtenu de lui.

ADRIEN lui accorda sa demande, et le créa Intendant des ouvrages qu'il falloit construire pour apporter des eaux dans cette ville. La dépense excéda sept millions de drachmes. Les ennemis de HERODES s'en plaignirent à l'Empereur, et lui représenterent, que le tribut de cinq cents villes avoit été sacrifié pour ce seul ouvrage. HERODES convint que la dépense avoit en effet excédé sa première estimation, mais il déconcerta ses calomniatrices.

lomniateurs, en prouvant qu'il avoit fourni l'excédant de ses propres fonds.

CET aqueduc, dont les ruines s'étendent à plus d'un mille vers le nord, ou vers l'Hellespont, n'est pas le seul monument que ce grand homme ait élevé dans le cours de sa vie ; il batit entr'autres le stade d'Athènes, qui subsiste encore aujourd'hui, et dont la magnificence est tant vantée par PAUSANIAS.

Les murailles d'Alexandrie sont presqu'entièrement conservées ; elles ont huit pieds d'épaisseur, sont construites en pierre de taille, et flanquées de tours. La colline qu'elles renferment, et sur laquelle la ville étoit située d'une manière très avantageuse, est séparée à l'est de la chaîne de l'Ida, par le vallon où coulent les eaux thermales, et s'étend en s'abaissant vers la mer, dans l'espace d'environ une demie lieue quartée.

Les fondateurs de cette ville, ne durent point être insensibles aux avantages qu'elle pouvoit tirer de sa situation à l'embouchure de l'Hellespont, et du voisinage de ces eaux thermales, célèbres encore aujourd'hui, par leur efficacité contre la lépre, les rhumatismes, et les maladies de peau : Il paroît que ses habitans n'ignorèrent pas non plus le prix du commerce, et l'utilité d'un port. La Nature avoit ébauché l'enceinte de celui, dont on admire aujourd'hui les ruines. Je ne fais si les énormes colonnes de granite qui sont jettées çà et là dans son vaste bassin, servoient autrefois à le décorer, ou si les Turcs, après les avoir roulées du haut de la ville, ont renoncé à les embarquer à cause de leur pesanteur.

LES édifices publiques sont toujours ceux qui résistent le mieux aux injures du tems. On reconnoit encore parmi les ruines d'Alexandrie, un stade, un théâtre, deux temples, et une immense fabrique, que les navigateurs apperçoivent à la mer très loin, à travers les touffes de Valoniers qui couvrent maintenant l'espace qu'occupoit la ville.

POCOCKE et CHANDLER regardent cet édifice comme un gymnase, où la jeunesse étoit instruite dans les sciences, et des

VOL. III. b exercices

exercices du corps *. Le commun des navigateurs lui donne le nom de *Palais de PRIAM*, sans songer que ce palais devoit être fort éloigné de la mer, et que celui-ci est presque sur ses bords.

QUANT à moi, j'ai été frappé à la première vue de la ressemblance de cet édifice avec les thermes de DIOCLETIEN et de CARACALLA, qu'on voit à Rome ; mais ce qui m'a entièrement convaincu qu'il étoit destiné à l'usage des bains, c'est ce grand édifice semicirculaire qui se trouve à l'angle méridional du monument, et dans lequel aboutissent les canaux de l'aqueduc qui y apportoient les eaux. Si POCOCKE et CHANDLER, avoient vus ces canaux,—s'ils avoient pénétrés dans leurs voûtes encore enduites de sédiments aqueux,—s'ils avoient observé la direction de l'aqueduc qui s'y termine, ils n'auroient certainement pas méconnu sa destination.

LA vallée comprise dans l'enceinte des murailles, et qui les Turcs appellent *Brian-Déré*, est en partie artificielle ; elle est traversée dans toute sa longueur par un grand égout, où venoient sans doute aboutir toutes les eaux de la ville, et dont l'embouchure pour la grandeur et la construction, ne le céde en rien au grand égout bati à Rome par les TARQUINS.

C H A P. III.

Voyage d'Alexandria Troas au Chateau d'Asie nommé Koum-Kalé.

A PRÈS avoir scrupuleusement examiné, mesuré, et dessiné tous les monumens d'Alexandria Troas ; après avoir fixé géométriquement leur position, tant entre eux que relativement

* A description of the East, vol. ii. part. ii. p. 109. Travels in Asia Minor, p. 27.

à l'île de Tenedos, qui est en face, je continuai ma route, en cotoyant toujours la mer Egée.

JE trouve d'abord une vaste plaine, que j'aurois été tenté de prendre pour celle de Troye, si j'y avoit reconnu la trace de quelque fleuve. Je laisse ensuite à ma droite les villages de *Dabri*, de *Gbeiffik*, et de *Bos*, et j'arrive enfin, à travers une longue chaîne de basses collines sans culture, au pied d'une éminence conique, évidemment artificielle, que j'avois apperçue à l'horizon dès le moment où j'avois quitté les murs d'Alexandrie. Cet objet remarquable attira toute mon attention par sa forme régulière, par sa masse énorme, par sa hauteur, qui n'est pas au dessous de cent pieds, et par son contour, que je trouvai de quatre cent pas.

J'ÉTOIS très empêtré de savoir, si les Turcs qui habitent les villages voisins avoient coutume de désigner cette petite montagne par quelque nom particulier. Ma curiosité fut pleinement satisfaite, lorsque j'appris qu'ils la regardoient comme un tombeau des infidels, et qu'ils lui donnoient le nom très extraordinaire de *Tapé* ou *Tepé*, accompagné du nom du village le plus voisin, qui est *Udjek*.

EN observant la forme de ce monument, et la parfaite ressemblance du nom *Tapé*, que les Turcs lui donnent, avec celui que les Egyptiens donnoient à leur tombeaux, je ne pouvois guères me refuser à croire, que celui-ci en étoit un lui-même, ou du moins une de ces montagnes sacrées sur lesquelles les peuples d'Asie avoient coutume d'offrir des sacrifices : Mais comme je n'avois encore aucune idée de la plaine de Troye, qui cependant se trouvoit alors bien près de moi, je ne pouvois que former des conjectures, mais point asséoir d'opinion sur la nature de ce monument. Ce ne fut que dans la suite, je pourrois dire même après le troisième voyage fait dans la Troade, que je pu pronoicer un jugement raisonné sur ce monticule, et sur tous ceux de la même espèce qui se trouvent dans la plaine de Troye ; je me contentai pour lors d'en mesurer la hauteur et le contour,

et de détailler de son sommet l'un des plus beaux points de vue qu'il y ait au monde. Au midi j'apercevois les ruines d'Alexandrie, à plus de quatre lieues de distance ; à mes pieds, du côté du nord, une immense plaine entourée de charmantes collines ; à l'est, les pics de l'Ida ; et à l'ouest, la mer Egée, les îles de Tenedos, d'Imbros, de Samothrace, de Lemnos, et jusqu'au sommet du mont Athos.

A UN mille environ de ce monument, on trouve le village d'*Erkefighi*; près duquel lorsque j'y passa, le fameux HASSAN, dernier Capitan Pacha, faisoit batir un joli *Kiosk* ou *Tchiflik*, pour pouvoir s'y reposer lorsque la flotte Turque, au retour de sa croisière dans l'Archipel, ou de quelqu'autre expédition, attend les vents de sud, à l'embouchure de l'Héllespont.

QUELQUES jours avant mon arrivée, ses architectes avoient fait transporter d'Alexandrie un magnifique Sarcophage de marbre blanc, pour en faire l'auge d'une fontaine. Je fut encore plus choqué du vil usage auquel on destinoit ce monument précieux, lorsque j'aperçus sur une de ses faces les restes d'une inscription Grèque, dont j'avois trouvé le commencement à Alexandrie, parmi les morceaux que ces barbares avoient détaché du Sarcophage pour le façonner à leur bizarre fantaisie.

Au dessous du Kiosk dont je viens de parler, on voit un ruisseau considérable, dont les eaux parfaitement limpides, après avoir suivie la chaîne des collines qui s'étendent vers le sommet de la grande plaine, semblent avoir été détournées de leurs cours naturel, pour suivre un nouveau canal qui les porte dans la plaine voisine. Il n'est pas difficile d'apercevoir, que c'est la main des hommes qui a changé le cours de ce ruisseau. Son lit, généralement très peu profond, en formant de nombreuses sinuosités, avant de parvenir au dessous du Kiosk, acquiert là, tout d'un coup, une grande profondeur, il suit une ligne rigoureusement droite ; et l'on voit sur ses bords un talus très élevé, formé par les terres qu'on en a retirées pour le creuser..

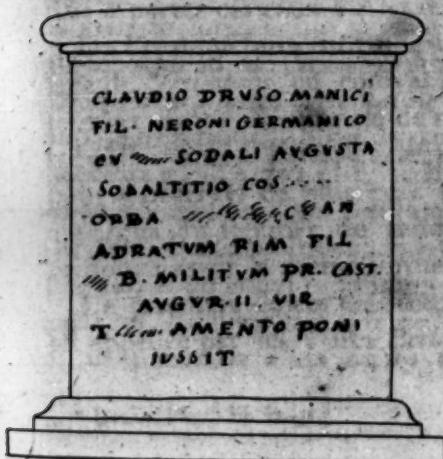
Vous.

Inscription trouvée sur un Sarcophage au village d'Erkofsigi.

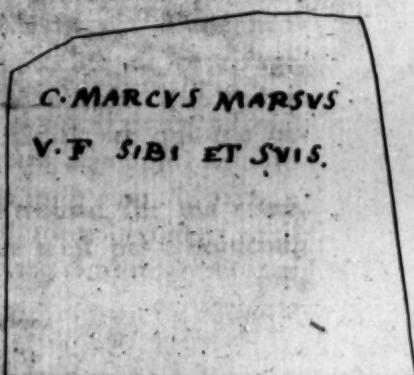
MARKVS PAULINVS AELINVS AURILIVS
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ΠΑΥΛΕΙΝΟΥ ΤΟΥ ΚΑΙ ΓΕΝΟΜΕΝΟΥ ΠΑΓΚΡΑΤΙΑΣΤΟΥ ΟΥ
ΚΑΙ ΣΕ ΤΩΣ ΜΙΝΘΕΙΔ ΕΣΤ· ΙΚΕΝΑΝΔΡΙΑΣ ΚΑΙ ΕΝΟΒΕΕΝΤΟ
ΑΙΚΑΙ· ΠΕΙΩΣ ΕΘΝΑΤ· Ν ΣΙΦΡΟΝΕΜΑΥΤΟ ΚΑΙ ΤΑ ΓΛΥΚΥΤΗΤΟ
ΠΑΡΙΓΔΠΤΩΤΕΓΡΑΜΜΕΝΩ ΑΥΡΙΛΙΟ ΠΑΥΛΕΙΝΩ ΚΑΙ ΤΟΙΣ ΕΚΤΟΥ
ΕΝΡΙΖΜΟΥ . ΕΙΔΡΤΕΤΟΛΜΗΣ ΗΝ ΔΙΣ ΑΙ ΤΑΥΤ· Ν Τ· ΙΝΕΟΡΟ ΜΕΛ
ΚΡΟΝΑΛΛΟΤΗΙΟΝ· ΙΟΣΤΕΗ ΤΝΟΣ ΣΛΚΑΤΑ ΘΕΣΒΙΑΔΣ ΕΠΡΟΣ ΦΙ
ΜΟΥ· ΤΗ Βραδε ολολει

❖ = ΒΦΙ ΚΑΙ ΤΟ ΙΕΡΩΤΑΤΩ ΖΑΜ .

N° 2. Inscription trouvée sur une pierre
sepulcrale au village de Komatti. Verez p. 26.



N° 3. Inscription trouvée près la fameuse
inscription Sigéone. Verez p. 28.



THE COUNCIL OF THE STATE OF CALIFORNIA
APPROVED AND ADOPTED THE COUNCIL BILL NO.
10747, WHICH WAS PRESENTED TO THE SENATE
BY THE ATTORNEY GENERAL, AND WHICH WAS
SUBMITTED TO THE SENATE BY THE SPEAKER
OF THE HOUSE OF REPRESENTATIVES, AND
IS APPROVED AS FOLLOWS:

16. A. *Spatuliger* in *luteus* sp.

Vous n'etes pas surpris, Messieurs, de me voir m'appesantir sur la description d'un simple ruisseau ; tout devient intéressant quand on croit approcher de la plaine de Troye :

*Nullum est sine nomine faxum **.

Ce seroit un crime d'y négliger quelque chose ; il ne faut pas imiter CESAR, qui passa sur le Scamandre sans le reconnoître.

*Inscius in sicco serpentem gramine rivum
Transierat, qui Xanthus erat †.*

Je suis donc le cours de ce joli ruisseau jusqu' à son embouchure dans la mer Egée. Là j'apperçois un marais couvert de roseaux très épais et très élevés ; et, à peu de distance, un moulin, qui pourroit bien être la véritable cause pour laquelle on a détourné le ruisseau de son ancien cours. Cette conjecture est d'autant plus fondée, que tous les villages d'alentour sont réduits à la ressource des moulins à vent, — ressource très précaire dans un pays aussi tempéré que cette partie de l'Asie. Il ne seroit pas surprenant que le cours de ce ruisseau, n'est été détourné par HERODES ATTICUS lui-même, et que l'aqueduc dont les ruines s'étendent vers la plaine de Troye, n'eut été destiné à porter ces eaux à Alexandria Troas.

De l'embouchure du ruisseau je dirige ma route vers le village de *Jeni-chebr*, en cotoyant le rivage de la mer, qui dans tout cet espace est composé de rochers taillés à pic, d'une hauteur effrayante : J'étois curieux de m'approcher de ce rivage, pour y observer de plus près differens monticules que j'avois apperçus du sommet du monument d'Udjek, et qui me paraisoient avoir la même forme que lui.

La première de ces éminences que je trouvai sur ma route, est appellée par les Turcs *Beebik-Tapé*, et n'est pas à beaucoup près.

* LUCAN. Pharf. lib. ix. 973.

† Ibidem.

près aussi élevée que celle d'Udjek. Près d'elle on voit une tranchée artificielle, pratiquée dans l'épaisseur de la montagne, dont il n'est pas aisé de désigner le motif ni l'usage. Un peu plus loin je trouvai la second éminence, qui me parut de la même dimension que la précédente ; et comme elle, très bien exposée à la vue de navigateurs qui entrent dans l'Hellespont. Je n'ai point pu découvrir quel nom les Turcs donnoient à celle-ci, mais je suppose qu'elle prend, comme beaucoup d'autres, le nom du village qui l'avoisine.

Le village de *Jeni-chebr*, peuplé de Grecs, et situé sur la pointe d'une promontoire élevé, qui avec celui de la Chersonese de Thrace forme l'entrée du canal de l'Hellespont. Au moment où j'allois entrer dans l'église, j'apperçois sur un bloc de marbre ces deux mots à peine lisibles, ΦΑΝΟΔΙΚΟ ΕΙΜΙ — c'est le commencement de la fameuse inscription Sigéenne, connue de tous les érudits, et dont CHISHULL* a donné une description particulière.

EN face de l'inscription, à gauche de la porte de la même église, on voit aussi un bas relief, en marbre, de la plus belle exécution. Il représente une femme assise ; des nourrices tenant des enfans emmaillottés dans leurs bras, semblent les présenter à la figure assise. Un autre personnage vient à la suite des nourrices, et porte un petit coffre de la main droite, et une espèce de coquille de la gauche.

LE DR CHANDLER a parfaitement expliqué ce bas relief :
 " On fait," dit il, " que les Grecs avoient coutume de mettre
 " leurs enfans sous la protection de quelque divinité, et que les
 " nourrices alloient les lui présenter le cinquième jour après
 " leur naissance. Les Romains avoient aussi la même superstition ; et CALIGULA se souvient d'avoir placé sa fille LIVIA DRUSILLA dans le giron de Minerve. Il est bien naturel de croire que le bas relief ci-dessus représente cette cérémonie des nourrices ; que la figure assise est la Déesse MINERVE, et

" que

* Voyez Antiq. Asiatique ; aussi Inscriptiones Antiquae ; par CHANDLER.

" que le petit coffre porté par la dernière figure, renferme l'encens, et les offrandes destinées à la Déesse*." Vous concevez aisément, Messieurs, l'extrême désir que j'eus d'enlever ces deux intéressans monumens, et vous me pardonnerez même peut-être les tentatives que je fis, et les dangers auxquels je m'exposai, pour les arracher à leur obscurité et à leur destruction prochaine. Mais le marbre sur lequel se trouve l'inscription, est renommé parmi les Grecs, comme le remède le plus souverain, et le plus efficace, contre la fièvre intermittente. On y place la malade, il s'y couche, il s'y roule, et tout le monde le croit guéri; en attendant il efface toujours de plus en plus les précieux caractères du monument, et peut-être, hélas! au moment où je parle, il n'en existe plus aucune trace. La superstition des Grecs fut insensible à mes prières, et leur finesse vigilante déconcerta toutes mes ruses. Au reste, comment aurois-je pu réussir dans une entreprise où l'or des savans Anglais, et les menaces de HASSAN, plus éloquentes encore, avoient échoué?

A peu de distance du village de Jeni-chehr, je me trouvais sur la pointe d'un haut promontoire, qui domine la vaste plaine dont j'ai déjà parlé. Le torrent qui la traverse étoit alors à sec, mais sa largeur et l'irrégularité de son lit, annoncent assez ses ravages, et son impétuosité. Un grand marais occupe à droite et à gauche les environs de son embouchure, et s'étend presque jusqu'au pied d'une mauvaise fortresse, que les Turcs appellent *Koum-Kalé*, 'le chateau du sable'; sans doute parcequ'il est bâti sur les sables que le torrent amoneé à son embouchure.

LORSQUE je parcourrois des yeux ces différens objets, j'aperçois au pied du cap où j'étois assis, deux monticules situés l'un près de l'autre, et absolument semblables à ceux que je venois d'observer sur la crête du promontoire. Un Grec de Jeni-chehr m'apprend, que le plus considérable de deux, le plus voisin du rivage de la mer, est appellé *Dios-Tapé*. Ce nom très-

* Travels in Asia Minor, c. 12..

très extraordinaire me fournit, comme on peut le penser, matière à beaucoup de réflexions, que j'eus occasion de développer, à mesure que j'avancai dans la connoissance de la plaine et de ses monumens; mais je me contentai pour lors de prendre quelques mesures de leur dimensions, et je continuai ma route.

LE chateau voisin du cap, bati à l'embouchure du fleuve qui baigne ses murs, consiste en une médiocre enceinte de hautes murailles, flanquées de tours, que les Turcs ont grand soin de blanchir, afin de les rendre plus apparentes, et de les exposer davantage au canon de l'ennemi. Le pied de ces murailles est percé de plusieurs larges embrasures, à travers lesquelles d'énormes canons vomissent des boulets de marbre, dirigés à fleur d'eau. Ces canons sont placés sur de simples madriers. Ils ne peuvent jamais tirer qu'un seul coup sur le même vaisseau, parceque le recul les déplace, et il faut des efforts infinis pour leur rendre leur première position.

UNE pareille batterie n'est donc point suffisante pour arrêter une flotte ennemie, qui seroit secondée par un vent favorable; celle qui sont situées du côté opposé, sur la pointe de la Chersonese de Thrace, et qui ont été baties par le célèbre Baron de TOTT, seroient sans doute d'une excellente défense, si les Turcs favoient en faire usage; mais leurs ennemis naturels, les Russes, n'ignorent pas leur impéritie dans l'art militaire; et si dans la guerre qui a précédé celle-ci, les puissances intéressées à la conservation de l'Empire Turc, n'avoient pas arrêté leurs succès, ils se disposoient à braver le canon des chateaux, et à aller conclure la paix sous les murs du sérail.

C H A P. IV.

Voyage de Koum-Kalé au Mont Cotylus, l'un des plus hauts sommets de la chaîne de l'Ida.

LES fatigues du voyage m'ayant forcé de prendre un peu de repos, je m'arrêtai quelques jours dans un *Caravan-strai*, au village de Koum-Kalé, situé près du château. Lorsque je fus en état de continuer mes courses, je traversai le fleuve tout près de son embouchure, et je l'y trouvai large de plus de trois cents pieds. Dans les marais qui le bordent, je reconnus de petits lacs d'eau douce, et d'eau salée ; et je fus frappé de la quantité prodigieuse de roseaux et de tamarins que je trouvai sur ma route, en cotoyant le rivage de la mer.

ENFIN après un demie heure de marche, je vois à une grande distance un monticule dans le genre de tous ceux dont j'ai déjà parlé. A mesure que j'en approche, je découvre une large ouverture pratiquée dans ses flancs, et plusieurs pans de murailles en ruines, qui paraisoient en être la charpente, ou les fondemens. Je m'élançai sous cette voute, je la parcourue avec avidité dans toute sa longueur, et dans une autre dimension transversale, que j'y trouve ; j'examine la nature des matériaux, le ciment qui les unit, et je recueille avec enthousiasme le nom très intéressant de *Tapé* qu'on lui donne encore.

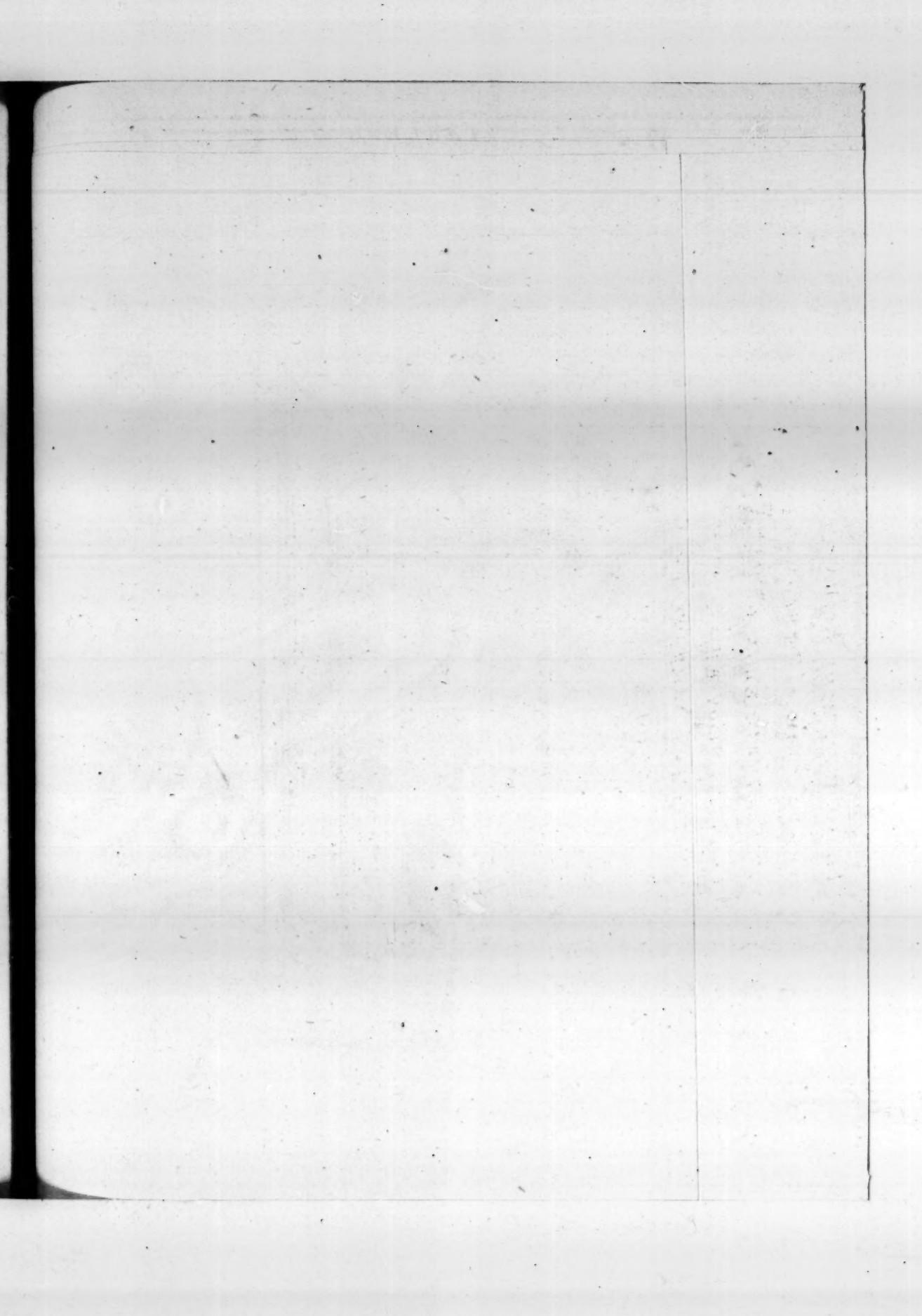
Ce n'est pas tout, j'observe que ce monument se trouve à la pointe d'une avance, ou langue de terre, qui se prolonge dans la plaine, exactement en face du cap de Jeni-chehr. Que de brillantes conjectures s'élèvent alors dans mon esprit ! mais encore une fois, il n'est pas tems de former un système, et les données ne sont pas suffisantes.

APRÈS avoir jetté un coup d'œil sur un petit port voisin, que les Turcs appellent *Karanlik-Limani*, le port fermé, je poursuis ma route le long du rivage de l'Hellespont, jusqu'au village de *It-Guelmes*. Je fus surpris de la quantité de figuiers sauvages qui croissent aux environs de ce village ; et ce fut la raison qui m'engagea à me faire répéter son nom, pour découvrir s'il ne feroit point quelque allusion aux productions du terrain qui l'environne ; un Grec me répondit qu'on l'appelloit indifféremment *It-Guelmes* ou *Erin-Keu* : Ce dernier nom me rappela celui d'*Erineos*, qui signifie " lieu fertile en figuiers sauvages." Je me souvins, en même tems, qu'il y avoit près de la ville de Troye une colline de ce nom, vers laquelle ANDROMAQUE cherchoit à diriger l'attention d'*HECTOR*, comme étant le seul endroit par où la ville pouvoit être attaquée* ; j'allois en conclure que la ville ne devoit pas être éloignée de l'endroit où je me trouvais ; mais il n'y avoit autour de moi, ni Simois ni Scamandre, et j'étois d'ailleurs immédiatement sur les bords de la mer, situation qui ne pouvoit s'accorder avec celle de l'ancienne Troye.

IL me parut alors d'autant plus inutile de m'avancer au delà d'*Erin-Keu*, que je n'avois pour toute perspective qu'une longue chaîne de montagnes, qui s'étendoit du côté du nord et du nord-est, jusqu'à l'horizon. Je revins à peu près sur mes pas, dans le dessein de suivre les contours de la vaste plaine que j'avois admirée du sommet de l'eminence d'*Udjek*, et du cap de *Jeni-chehr*.

BIENTÔT je descends dans un charmant vallon, que les Turcs appellent *Tbimbrek-Deré*, vallée de *Tbimbrek*. Cette vallée va se terminer en s'élargissant dans la grande plaine. J'allois remonter jusqu'à sa source le ruisseau qui la parcoure, lorsque je fus arrêté sur la rive gauche, près du village de *Halil-éli*, par un énorme monceau de ruines, au milieu desquelles j'aperçus des

* Iliad. vi. 433. xi. 167. xxii. 145.



177. Inscription trouvée dans les ruines du Temple d'Apollon Thymbrién,
sur un pâté de colonne.



ΙΠΟΤΗΓΑΠΛΙΙΗΘΕΙΣΘΕΥΛΗΣ
ΤΟΥ ΙΕΡΟΥ ΑΡΤΥΡΟΥ ΕΚΚΕΛΕΥΣΕΩ
ΝΗΟΣΙΩΤΑΤΩΝ ΗΓΙΩΝ ΑΥΤΟΚΡΑΤ
ΩΝ ΔΙΟΚΛΗΤΙΑΝΟΥ ΚΛΙ ΜΑΞΙΜΙΑΝ
ΩΝ ΕΙ φΑΝΕ ΓΤΑΤΙΝ ΚΑΙ ΤΑΡΨΩΝΤ
ΑΛΜΑΤΟΥ ΔΙΟΣ ΚΑΤΑΣΚΕΥΑ ΣΕΘΕΝΟΙ

ΑΛΜΑΤΟΥ ΔΙΟΣ ΚΑΤΑΣΚΕΥΑ ΕΘΕΝΟΙ
ΥΛΕΒΕΣΤΑΤΟΙ ΗΜΩΝ ΑΥΤΟΚΡΑΤΟΡΗΝ
ΑΙΩΝΙ ΦΑΝΕΣΤΑΤΟΙ ΚΑΙ ΣΑΡΕΙ
ΑΟΙΕΡΨΕΑΝΗΗΘΕ ΉΛΕΒΔΟΜΗ

ΚΟΝΤΑ ΕΜΠΕΑΤΟ ΕΠΤΑ ΙΓΡΙΞΟΗ

ΒΑΙ ΚΟΥΣΤΑΘΜΟΥ ΕΠΙΑΝΕ. Σ. Λαζ.

ΦΑΝΕΤΟΥΤΟΥ ΛΑΝΠΡΟΤΑΝΟ

ΑΣΙΑΣ

1^η ΛΤΤΑΔΙΣ φι
ΕΞΤΟΝΙΟΥΛΙΟΝ φι
ΤΩΝ ΚΟΣΜΟΝ ΤΗΣ Τ
—ΩΖ ΣΠΑΡΧΟΝ ΣΠΕΙΡΗΣ
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ΜΕΤΡΗΣΑΝΤΑ ΤΟΥΣ
ΤΕΒΟΥΛΕΥΤΑΣ ΚΑΙ ΠΟ
ΛΕΙΤΑΣ ΠΛΑΝΤΑΣ ΑΙ
ΛΕΙΤΑΣ ΕΚΛΟΥΤΗΡΩΝ

THESE ARE THE LINES OF THE
MATERIALS WHICH ARE USED IN
THE PREPARATION OF THE
FOODS WHICH ARE EATEN BY
THE PEOPLE.

N.2. Bildem.

ΙΛΙΕΙ ΚΑΙ ΜΠΟΛΕΙΕΙ ΚΟΙΝΩΝΟΥΣΑΙ ΤΗΝ Η
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ΤΑΣ ΑΝΘΡΟΠΩ^ς
ΙΠΠΑΡΧΟΣ Η ΤΗΣ ΙΔΙΟΥ ΙΔΙΕΥΣ ΣΥΝΕΔ^ς
ΟΝ ΤΟΝ ΑΝΑΡΙΑΝΤΑ ΑΝΕΘΗΚΕ ΝΕΚΤΩΝΙΑ
ΔΙΑ ΤΗΝΠΡΟΣ ΤΗΣ ΞΠΑΣΤΟΝ ΚΑΙ ΕΥΕΡΓΕ^ς
ΚΑΙ ΣΟΤΗΡΑ^ς ΣΑΥΤΟΥ ΕΥΣΕΒΗΝ.



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11. EN ΑΥΤΟΥ ΖΕΡΜΙΟΥ ΥΕΡΑΤΙΣ ΓΟΥΣ ΤΕ ΤΕΤΡΑΠΕΤΑΜΕΝ ΧΡΗΜΑΤ

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17. ΑΝΔΡΕΙΑΣ ΚΑΙ ΤΩΝ ΙΛΙΑΚΩΝ ΠΟΜΠΗΝ ΚΑΙ ΒΥΣΙΝΣ ΕΝΤΟ ΠΑΝΑΘΗΝΑΙΩΝ

18. ΤΟΥ ΤΟΥΣ ΑΠΟ ΤΗΣ ΠΡΟΣΟΔΟΥ

19. φίλης έρεον θομενοις φίλαρχαι εν το παναθηναιο

20. ΤΑ ΤΡΙΟΒΟΛΩΝA . . . φίλην αράχματι εκατον

21. ΕΥΣΑΙΒΟΙ ΘΗΛΕΙΑΙ . . . ΕΥΡΥΟΝΤΕΣ

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26. ΤΩΝ ΠΑΝΤΩΝ ΘΕΩΝ ΚΑΙ ΤΩΝ ΗΝΤΩΝ ΤΡΙΔΕΠΟΜΠΗΣ ΕΠΙΜΕΛΗΤΗ

27. ΦΙΚΑΤΑ ΚΑΛΟΣ ΠΟΜΠΕΥΔΣ ΙΝ ΔΣ ΚΑΙ ΤΗΝ ΚΑΙ . . . ΤΩΝ

28. ΤΟΥΣ ΤΗΣ ΕΥΤΑΞΙΑΣ ΕΠΙΜΕΛΗΙΟΜΕΝΟΥΣ ΕΠΙΣΙΑ ΠΟΜΠΗΣ ΚΑΘΙΣΤΗΝ

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ΕΚ ΤΩΝ ΒΑΣΙΛΙΚΩΝ

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N° 5. Ibidem.



N° 6. Ibidem

Inscription semblable à celle du N° 1. trouvée
sur un plaque de marbre.

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bas-reliefs, des colonnes, des chapiteaux, des entablemens, et des inscriptions.

SANS examiner si le monument qui avoit autrefois existé dans ce lieu, étoit un temple ou un autre édifice quelconque, pressé d'ailleurs par les menaces des habitans du village voisin, qui me soupçonnnoient de chercher des trésors parmi ces ruines, je me hâte de recueillir toutes les inscriptions, bien persuadé que quelqu'une d'entr'elles contiendroit les titres du monument, ou me fourniroit au moins les moyens de le reconnoître.

L'UNE de ces inscriptions fait mention d'une statue d'argent consacrée à JUPITER par DIOCLÉTIEN et MAXIMIEN, l'autre d'une statue élevée à AUGUSTE au nom des habitans d'Ilium, et des quarante villes d'Asie, qui célébroient en commun des fêtes ; celle-ci étoit gravée au pied de la statue d'un certain ATTALUS, fameux lutteur, dont ESCHINES parle dans sa lettre sur la Troade * ; celle-là contient le cérémonial des fêtes Panathénées ; la dernière enfin est un hommage rendu à APOLLON par les habitans d'Ilium.

TOUTES ces inscriptions auroient suffi, sans doute, pour fixer la nature du monument dont je voyois les débris ; mais le caractère de l'architecture, et le plan de l'édifice que je démelai sans beaucoup de peine, achéverent de me convaincre que j'avois découvert un temple. Il étoit d'ordre Dorique, au moins à l'extérieur ; ses colonnes avoient dix huit pouces de diamètre. Quelques chapiteaux Corinthiens jettés ça et là, me firent soupçonner que la décoration intérieure pouvoit bien être de cet ordre.

ECHAPPE aux inquiétudes qu'e me causerent les habitans de Halil-éli, pendant le tems que je passai sur les ruines du temple, j'allai fixer la source du ruisseau qui parcourt la vallée de Thimbrek, et je le suivis ensuite jusqu'à son embouchure, dans le grand torrent de la plaine que les Turcs appellent Menderé.

* Lettre x. Voyez l'édition des Orateurs Grecs, par REISKE, vol. iii. p. 679.

Me voila donc encore une fois près de ce grand fleuve, qui paroît descendre du haut de l'immense plaine dont j'ai déjà parcouru une grande partie. J'entreprends de le remonter jusqu'à sa source, et d'observer les autres fleuves qu'il peut recevoir dans l'étendue de son cours. Cette entreprise étoit pénible. Il falloit se resoudre à suivre scrupuleusement toutes ses sinuosités ; il falloit braver les marais, les brossailles, et les difficultés de toute nature qui se présentoient à chaque pas. Aussi le Turc qui me servoit de guide, me prodiguoit-il sans réserve les témoignages les moins équivoques de sa commisération. Il me trouvoit bien fou de venir de si loin, et de m'exposer à tant de fatigues et de dangers, pour chercher des édifices ruinés, et des sources de rivière. "Infidel," me disoit-il de tems en tems, "n'as-tu point dans ton pays des rivières et de vieilles ma- fures ?"

APRÈS environ un heure de marche, j'aperçois sur la droite, le lit d'un petit fleuve alors à sec, couvert de plantes et de gazon. J'y entre, et en le suivant j'arrive aux bords de ce joli ruisseau qui j'avois traversé en descendant du village d'Erkessighi. Je ne doutai plus alors, que ce petit ruisseau n'allât autrefois se joindre au grand fleuve, comme je l'avois présumé d'abord, ni que le nouveau canal dans lequel il coule maintenant ne fut artificiel.

MON conducteur voyant le dégré d'intérêt qui j'attachois à connoître l'origine et l'embouchure des rivières, m'apprit que la source de ce joli ruisseau n'étoit pas éloignée. Il me montra même du doigt, au fond de la plaine, un groupe d'arbres et de verdure, d'où il m'affura qu'il sortoit.

AVANT de vérifier son assertion, je reviens vers le grand fleuve, au point où je l'avois quitté ; et je n'eus pas plutôt fait cent pas, en remontant toujours le long de ses bords, que j'aperçus les ruines d'un pont fabriqué en pierre de taille, et d'une construction si parfaite qu'il ne peut être que l'ouvrage des anciens. En face de ces ruines, sur la droite du fleuve, je vis encore

core une éminence dans le genre de toutes celles que j'avois déjà trouvées ; mais celle-ci étoit beaucoup plus ruinée que les autres. Il falloit même être aussi accoutumé que je l'étois à la vue de ces monumens pour pouvoir distinguer sa forme ancienne à travers ses débris.

Bien convaincu par les observations précédentes, que les deux fleuves avoient été réunis autrefois dans les environs des ruines du pont, je dirige ma route vers la source que mon conducteur m'avoit indiquée. J'atteignis bientôt les rives d'un petit fleuve ; la limpidité de ses eaux me frappa de plus en plus ; il coule avec une grande rapidité sur un fonds de sable et de cailloux arrondis, entre deux rives verdoyantes, qu'il ne franchit jamais, et qui, au printemps, sont émaillées de fleurs. Le pont sur lequel je le traversai étoit un vieux *faule* jeté d'un de ses bords à l'autre, près d'un moulin, où je trouvai plusieurs Turcs occupés à pecher des anguilles.

ON se figure aisément tous les souvenirs que les differens caractères de ce joli ruisseau rappeloient à mon esprit, et combien j'étois empressé d'arriver à ses sources. Rien ne sauroit égaler le plaisir et la surprise que j'éprouvai, lorsqu' après avoir traversé une plaine immenue, dans laquelle je n'avois pas rencontré un seul arbre, je me trouvai au milieu d'une petite forêt de faules, de lotos, d'ormes et de peupliers, qui s'étend jusqu'au pied des basses collines qui terminent la plaine.

LA matière dont ces collines sont formées est une espece de brèche ou *pouding*, qui à la première vue ne differe en rien d'une maçonnerie. Les pierres qui la composent sont réunies entr'elles par une espece de ciment de couleur rougeâtre ; et la Nature a tellement imité l'art dans ce cas particulier, qu'il faut observer avec le plus grand soin, pour dissiper l'illusion qu'elle excite. De nombreuses sources d'une eau claire et limpide s'échappent avec rapidité des crevasses de ce pouding, et forment, avant de se réunir dans un canal, le petit marais qu'on voit dans le vallon voisin. A l'embouchure de quelques unes de ces crevasses, je remarquai

remarquai des débris de murailles, dont la construction parfaitement solide, est indubitablement l'ouvrage de quelque peuple plus industrieux que les Turcs.

SUR la route qui conduit au village voisin, à environ quarante pas de la colline dont je viens de parler, je rencontrais une source insolée, et très abondante, qui jaillissait du fond d'un bassin, dont les bords étoient formés par deux pilastres de granite, et plusieurs fragmens de marbre. Quand après je revins dans la Troade vers la fin de Septembre, je remarquai q'une fumée épaisse s'élevait de cette source; et couvrait les arbres et les jardins d'alentour; en y plongeant ma main, je la trouvai chaude, et mon guide m'affura qu'elle l'étoit bien davantage encore vers le milieu de l'hiver.

ON conçoit facilement que des sources aussi abondantes doivent tout fertiliser autour d'elles; elles se partagent, en effet, en plusieurs petits ruisseaux pour arroser des jardins deliciieux, où elle font croître toutes sortes de légumes et de fruits; elles se réunissent ensuite dans un lit commun, bordé de roseaux très épais et très élevés.

JE monte au village voisin par une pente douce et facile, qui s'élève insensiblement de la plaine; je traverse d'abord une vaste cimetière, dont chaque tombeau est orné d'une colonne de marbre ou de granite; et j'aperçois près de la mosquée un large banc de marbre de Paros, porté sur deux appuis, dont l'un est un triglife du style le plus pur. Voila des monumens de l'art. N'y auroit-il pas en autrefois, quelque ville importante sur cette colline? le voisinage d'une plaine fertile, et des belles sources que je viens de voir, dans un pais où l'eau est si rare, et par consequent si précieuse, auroit été sans doute un puissant attrait pour ses fondateurs.

LE nom de *Bounar*, ou *Pounar-Bacbi*, tête de la source, que les Turcs donnent à ce village, est la traduction littérale du mot Grec *Képhros*, que je crois avoir rencontré dans HOMERE, lorsqu'il parle des sources du Scamandre.—Mais encore une fois, il n'est

n'est pas tems de faire des applications; continuons à rassembler des faits, et à comparer entr' eux les objets que nous avons découverts; leur situation, et leur distance respective, ne sont pas moins essentielles à connoître, que leurs qualités absolues.

EN gravissant toujours la colline qui s'élève, comme je l'ai déjà dit, du niveau de la plaine, et qui s'étend à près d'un mille au delà du village de Bounar-Bachi, je me trouve arrêté brusquement sur les bords escarpés d'un précipice d'une profondeur immense. Le torrent qui coule au pied de ce précipice est le même qui parcourt la plaine. Quand il est en fureur, il couvre de ses eaux l'étroit vallon bordé de rochers menaçans; que la Nature semble avoir destinés à contenir son impétuosité. Quand il est à sec, les habitans des villages voisins profitent de cet heureux intervalle pour cultiver ses rivages, rendus fertile aux dépens des contrés qu'il a dépouillées de leur fécondité.

Du sommet de cette éminence que les Turcs appellent *Balli-dabi, montagne du miel*, à cause des nombreux essaims qui se trouvent dans les rochers qui la composent, je découvre la grande plaine dans toute son étendue. Sa forme générale me paroît à peu près semicirculaire, les deux chaînes de collines qui l'entourent semblent se diriger, l'une vers le cap de Jeni-chehr, et l'autre vers la pointe de In-Tapé-Gheulu. La partie des collines de la droite qui s'étendent entre les villages d'Aktché et de Tchiblak, est plus riante et plus agréable que le reste; j'aperçois au loin les îles de Tenedos, d'Imbros, de Samothrace, et de Lemnos, le haut sommet du mont Athos, et la Chersonese de Thrace, située de l'autre côté de l'Héllespont.

Au moment où j'admirai les avantages de cette situation, et la beauté des points de vue, un spectacle nouveau vient enchanter mes regards; il faisoit une vent de sud très violent, dont j'avois déjà ressenti les effets dans la plaine, mais qui devint plus sensible, à mesure que j'avancai sur l'éminence de Balli-dahi, exposée de tous côtés à la fureur des vents, et sans aucun abri qui puisse l'en défendre. La flotte Turque secondée de ce vent favorable

vorale doublloit à pleines voiles le cap de Jeni-chehr, et entroit dans l'Hellespont. HASSAN PACHA qui la commandoit, revenoit victorieux de l'Egypte. Avec une poignée de soldats, et la terreur de son nom, il avoit defait la nombreuse armée des Mamelucs ; il avoit exterminé les Beys rebelles ; il emportoit leurs tresors à Constantinople, et emmenoit leurs femmes en captivité. C'est ainsi que les coffres du Grand Seigneur se remplissent, c'est par des assassinats multipliés que l'on subvient aux besoins sans cesse d'un grand Empire, qui n'a d'autre loix que la volonté d'un farouche despote, et d'autres ressources que les fruits de l'exaction.

Ces tristes reflexions ne m'occupoient pas alors. J'ignorois que la flotte du cruel HASSAN étoit chargée d'infortunées captives ; si je l'avois su, la vue de ces beaux vaisseaux qui m'enchantoit, ne m'auroit inspiré que de l'horreur.

LORSQUE cette flotte eut dépassé le cap, je revins à mes observations, et je remarquai avec étonnement, que j'étois entouré de quatre monticules, absolument semblables à tous ceux que j'avois trouvés sur ma route ; l'un d'eux cependant me parut avoir quelque chose de singulier dans sa structure ; je m'en approche, et je vois qu'il n'est pas comme les autres, un monceau de terre couvert de gazon, mais un énorme amas de cailloux jettés sans ordre les uns sur les autres. Sa forme conique paroît avoir été alterée ; il semble qu'on en ait voulu pénétrer l'interieur pour le fouiller.

CE n'est pas tout ; en examinant avec soin la superficie du rocher de Balli-dahi, je distingue des fondemens d'antiques édifices dont la maçonnerie a pris la consistance du rocher lui-même. Ces fondemens ne sont-ils point ceux de quelque ancienne ville ; et les colonnes de marbre et de granite qui décorent les tombeaux voisins, ne sont-ils point les débris de ses temples et de ses palais ? Je n'ai pas encore le droit de le dire ; je ne me permit pas même de le présumer ; mais je puis du moins assurer, que s'il y en avoit une, elle se trouvoit, comme je l'ai déjà remarqué,

marqué, au fond d'une plaine immense et fertile, et dans le voisinage d'une eau limpide, salutaire et abondante, qu'elle étoit entourée, presque de tous côtés, par d'affreux précipices, qui la rendoient imprénable, et que jamais situation ne fut plus favorable à l'emplacement d'une ville.

UN quart de lieue au sud-est de Bounar-bachi, on trouve le village d'*Arabler*. La colline qui s'étend entre ces deux villages, et qui fait face à la plaine, est le seul endroit par où l'on puisse atteindre à l'éminence de Bounar-bachi. De tous les autres côtés elle est environnée de précipices. Comme le torrent de Menderé étoit à sec lorsque je descendis sur ses bords, je me décidai à marcher dans son lit, et à continuer de le suivre jusqu'à sa source, à travers les troncs d'arbres et les rochers qu'il a roulé sur son passage. Des saules, des peupliers, des platanes, croissent et végétent paisiblement, au milieu des ravages et de la destruction qui les entourent ; et quoique à moitié déracinés, ils payent cependant encore à la saison, peut-être, pour la dernière fois, le tribut de leur foible verdure.

APRÈS avoir marché pendant près de cinq heures, entre le deux chaines de rochers escarpés qui bordent le vallon, j'arrive dans une plaine, beaucoup moins étendue que celle que je venois de quitter, et à l'entrée de laquelle, on voit un village considérable, que les Turcs appellent *Iné* ou *Ené*. Le pont de bois sur lequel on passe pour y entrer, est soutenu par deux colonnes de granite. Les murailles du *Caravanserai* sont couvertes d'inscriptions Grèques, mais entièrement indéchiffrables. Tout semble annoncer que ce village a aussi été bati sur les ruines de quelque ville ancienne ; il y en avoit une, à peu près dans ces contrées, que STRABON appelle *Aeneas*, et dont le nom n'est pas très méconnoissable dans celui d'*Ené*. Cette ville, dit STRABON*, étoit à cinquante stades de *Palæscepis*.

LE torrent qui baigne les murs du village d'*Ené*, et qui va se réunir au Menderé, prend sa source près du village de *Ba-*

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barlar,

* Geograph. lib. xiii. p. 900. Edit. Ainst. 1707.

barlar, à cinq heures de distance vers le midi. Il est à sec pendant une grande partie de l'année, et le pays qu'il traverse est herissé de montagnes.

Ne seroit-ce point ici le fameux Scamandre dont parle HOMERE ? Le voila qui se réunit à un autre fleuve, dont les caractères sembleroient indiquer le violent Simeois. On fait que ces deux fleuves se réunissoient autrefois ; — mais que dis-je ? les sources de ce Scamandre se trouveroient à quinze lieues de la mer, et des vaisseaux de Grecs ; et comment, d'ailleurs, les batailles qui se donnoient dans une plaine, entre les rives des deux fleuves, auroient-elles pu se donner dans des montagnes impraticables ? Je plaindrois l'observateur qui ne se croiroit pas arrêté par ces difficultés qu'HOMERE lui présente, et qui résolu de trouver un Scamandre à quelque prix que ce soit, appelleroit à son secours les convulsions de la Nature, et lui feroit enfanter des montagnes, plutôt que de renoncé à des systèmes extravagans *.

UNE longue et pénible excursion que je fis dans les environs d'Ené, et aux sources du torrent qui en est voisin, ne m'offroit aucun objet bien intéressant : J'eus seulement occasion d'observer quelques ruines au village d'*Eskuptchu*, que je crois l'ancienne Palæscepis ; une mine d'argent que STRABON place, en effet, dans les environs ; et au village de *Kemalli*, une inscription Latine, en l'honneur de DRUSUS.

JE revins à Ené, et je continuai mon voyage, en suivant toujours le lit du Menderé, et avançant vers la haute montagne, où l'on m'avoit assuré qu'il prenoit sa source ; j'apperçois sur ma route, les differens villages de *Baloukli*, de *Kefil*, de *Tebiaouch*, et j'arrive enfin à celui d'*Audgiler*, ou *des chasseurs*, qui se trouve au pied de la montagne que je cherchois depuis si long temps, au prix de toutes sortes de fatigues et de dangers ; car il est bon d'observer, que tous les montagnards ne se ressemblent pas ; et que ceux de la Troade, en particulier, ne sont pas, à beaucoup près, aussi maniables,

* Voyez Wood's Description of the Troade, *passim*.

maniables, et aussi doux, que ceux de la Suisse, ou du nord de l'Ecosse.

CETTE montagne que les Turcs appellent *Kas-Dabi*, *la montagne de l'oie*, fait partie de la longue chaîne de l'Ida, qui s'étend du nord au midi, et dont les rameaux sont projetés, en s'abaissant du côté de l'est et de l'ouest. C'est ce mont *Cotylus*, d'où STRABON, trompé par DEMETRIUS, fait descendre le Scamandre, qu'il confond avec le Simois *, comme je montrerai dans la suite.

PENDANT que je me préparais à en atteindre le sommet, et que mes guides m'entretenoient des peines qu'ils alloient effuyer pour m'y conduire, une pluie affreuse me força de différer cette grande entreprise. Il fallut attendre que les sentiers devinssent praticables, et ils ne le furent qu'au bout de trois jours.

ALORS je me mis en marche à travers de bois remplis de bêtes fauves, et de gibier de toute espece, qui fait la principale nourriture, et le principal commerce du village d'Audgiler, entièrement peuplé de chasseurs. Après avoir monté pendant quatre heures, et traversé plusieurs torrents, qui, grossis par la dernière pluie, rouloient en s'écumant au fond des précipices, j'atteignis enfin le sommet de cette montagne, qu'HOMERE a si bien dépeinte, en disant, que "mille ruisseaux en découlent, et "que ses noires forêts son remplis de bêtes fauves †."

O ! vous peintres et poëtes orgueilleux de vos tableaux, je vous attends par un beau jour, sur le sommet de l'Ida : Venez y briser votre orgueil, et vos pinceaux, contre les chef-d'œuvres de la Nature ! Comparez donc, si vous l'osez, vos productions mesquines, avec ses sublimes ouvrages ; n'êtes-vous pas accablés, anéantis, par la grandeur, et l'inimitable variété des objets quelle étaie à vos yeux ?

QUEL est celui de vous, qui hazardera de me peindre ce ciel pur et azuré ; ces nuages légers et vaporeux qui le sillonnent ;

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* Geograph. lib. xiii. p. 898.

† Iliad. viii. 47. xi. 183. &c.

la masse imposante de ces montagnes accumulées ; la blancheur éblouissante de la neige qui les couronne ; la profondeur effrayante des précipices ; le fracas du torrent qui se brise contre les rochers ; ces groupes d'arbrisseaux, penchés sur la surface de ses eaux, qu'ils colorient de leur verdure, en s'y réfléchissant ; ces blocs monstrueux de granite, dont les uns sont suspendus sur la tête du voyageur, et les autres déjà détachés de la montagne, sont foiblement soutenus sur les bords du précipice ; les sommets bouleversés des collines inférieures, semblables aux vagues agitées d'une mer en courroux ; ces fleuves nombreux, qui s'échappent à travers les vallons et les plaines ; et ces deux mers immenses, la Propontide, et l'Egée, dont les eaux, frapées des rayons du soleil, semblent enflammer les deux extrémités opposées de l'horizon ?

Vous pouvez, comme tous les hommes sensibles, éprouver la jouissance complète de toutes ces beautés ; votre cœur peut embrasser la foule innombrable des sentiments variés, que ce spectacle fait naître ; mais vos couleurs sont trop faibles pour les peindre, et vos cadres trop étroits pour les contenir ; vous pouvez, dans vos ouvrages, surpasser des rivaux encore plus mediocre que vous, mais ne vous flattez jamais d'atteindre la sublime de la Nature !

C H A P. V.

Second et troisième Voyage de Constantinople à Troye.

QUOIQUE je me fusse abstenu jusqu'alors, de porter un jugement, et d'arrêter mes opinions, sur la plupart des objets que je venois d'observer, on sent qu'il devoit m'être bien difficile d'écartier tous les souvenirs de ma mémoire, et de me refuser à l'évidence des applications que je pouvois faire. J'en-trevoyois de grandes découvertes isolées, mais il n'y avoit point encore d'ensemble dans mon système.

Du mont Idâ, je me rends à Constantinople. Lorsque j'y parlai de mon voyage dans la Troade, et des conjectures singulières que je formais, peu s'en fallut qu'on ne me crut l'esprit aliéné ; on s'amusa long tems aux dépens de ce qu'on appelloit *mes Tombeaux*, et *mon Scamandre* ; mais les plaisanteries ne me firent point perdre courage. Je retournai bientôt dans la Troade, avec M. CAZAS, l'un des plus habiles dessinateurs de l'Europe, qui arrivoit alors de Palmyre, et qui dans le moment actuel, prépare à Rome, un riche supplément à l'ouvrage de Mr WOOD.

Nous partimes ensemble de Constantinople, sur un vaisseau Grec, dont le capitaine, fort avancé en age, naviguoit dans l'Archipel depuis sa plus tendre enfance. Je profitai de ses connaissances, pour vérifier dans l'Hellespont la situation de Lampsaque, des ports de Sestos et d'Abydos, de l'ancienne Dardanus, et de tous les fleuves qui se jettent dans ce canal fameux. Mais ce n'est point ici le lieu de faire connoître mes travaux sur cette partie de la Grèce ; je me suis borné au seul tableau de la Plaine de

de Troye ; le théâtre de l'Iliade, quoique circonscrit dans un très petit espace, est bien digne de m'employer tout-entier.

Nous arrivâmes donc, M. CAZAS et moi, à Koum-Kalé, au moment où le soleil alloit disparaître derrière le haut sommet de mont Athos. Le ciel étoit serein, et sans nuage ; la couleur azurée des pics d'Imbros, et de Samothrace, contrastoit d'une manière admirable avec le longue faisceaux de lumière, que le soleil lançoit à travers le ciel le plus pur. Ce tableau me rappela ce que j'avois autrefois lu dans PLINE, et regardé comme une fable ; ce naturaliste prétend, que l'ombre du mont Athos s'étendoit, dans certaines saisons, jusques dans le marché de Myrina, ville de l'île de Lemnos, située à quatre-vingt sept milles du mont Athos.

LE témoignage de PLINE à ce sujet, ne m'avez pas paru plus digne de fois que celui de STRABON, qui assure, que les habitans du sommet de la même montagne, voyent le soleil levant, trois heures plutôt que ceux qui habitent le rivage de la mer. J'inclinois fort à ranger ces deux assertions sur la même ligne, lorsqu'en jettant les yeux dans l'ouest, j'aperçus un immense cône d'ombre, dont la pointe étoit au sommet de l'Athos, et dont la base projetée horizontalement, sembloit raser la surface de la mer, et se diriger vers l'île de Lemnos. Dans peu de momens, cette ombre s'éleva dans l'atmosphère, se dissipâ, et perdit peu à peu sa forme, à mesure que le soleil descendit au dessous de l'horizon. Il n'en fallut pas davantage pour justifier PLINE à mes yeux, mais STRABON ne l'est pas encore, et ne fauroit l'être.

LA vigilance des Turcs, paroiffoit devoir être un grand obstacle aux operations géographiques, que je voulois entreprendre ; pour y échapper, je m'avisaï d'un stratagème, qui me procura la liberté de déployer mes instrumens dans tout le pays, sans éprouver aucun désagrément. Je plantai hardiment mon graphomètre sous le canon même du chateau : Aussitôt les Janissaires m'entourent ; sans paroître intimidé de leur présence, je

je tachai de fixer leur attention sur la bouffole du graphomètre, qu'ils connoissent comme une instrument de marine, et je leur demandai la permission de la vérifier avant de me mettre en mer. Les Turcs ont une confiance, et une crédulité, qui sont l'apanage de leur grand caractère, et le résultat de leur profonde ignorance. Chacun des Janissaires s'empresse de m'être utile ; l'un porte le pied de l'instrument, l'autre la chaîne, un troisième les piquets ; et tous se réunissent, pour m'aider à faire un ouvrage pour lequel ils m'auroient empalé, s'ils en avoient connu les funestes conséquences.

CETTE ruse que j'employai dans le reste de la Troade, fut par tout suivie du même succès. M. CAZAS dessina tous les monumens ; mais il s'abstint pour le moment, d'y placer des figures, depuis qu'un Emir * lui eut prouvé, d'un air menaçant et courroucé, qu'il feroit comptable devant Dieu, de tous les petits hommes qu'il engendroit avec son pinceau.

CE second voyage, et un troisième, que je fis ensuite, dans la Troade, ne laissèrent pas que de me fournir de nouvelles idées, et de rectifier les erreurs que j'avois pu commettre dans le premier.

C H A P.

* Secte particulière de Turcs, qui se croient de la famille de MAHOMET ; et qui sont pour cette raison, plus orgueilleux, et plus fanatiques que les autres.

C H A P. VI.

Histoire de plus célèbres voyageurs, tant anciens que modernes, qui ont visité la Plaine de Troye.

IL est tems maintenant, Messieurs, de vous communiquer mes opinions et mes conjectures sur les differens objets que je viens de décrire ; mais avant tout, pour vous préparer à les adopter sans répugnance, et à ne pas vous effrayer de leurs singularité, je vais m'étayer d'abord du témoignage des plus célèbres voyageurs tant anciens que modernes.

LA longue durée de la guerre de Troye, n'est pas, comme l'on fait, une fiction de la poésie, c'est une vérité de l'histoire. Pendant dix ans, les peuples de la Grèce ravagerent la côté d'Asie, et les îles qui y sont adjacentes. La capitale de la Troade ne fut pas toujours l'objet de leurs combats ; ils y revenoient, sans doute, par intervalle, et ce ne fut, à ce qu'il paroît, que la dernière année qu'ils l'attaquerent avec leurs forces réunies. Fut-elle prise, ou résista-t-elle à tous les efforts des Grecs, comme quelques historiens l'ont prétendu, c'est ce que je ne me flatte pas de décider ; mais ce qu'il y a de certain, c'est que pendant cette dernière campagne, il périt, de part et d'autre, un grand nombre de guerriers illustres, auxquels, suivant l'usage, on éleva des monumens, au milieu même des batailles.

LE grand intérêt de cette guerre, dut mettre en mouvement la Grèce et l'Asie, pendant qu'elle dura ; lorsqu'elle fut terminée, les soldats, et les généraux, qui en avoient été les acteurs, à leur retour dans leur patrie commune, durent en faire la

la matière de leurs récits, et l'instrument de leur renommée.

L'HISTOIRE et la poésie s'emparerent aussitôt de ces grands événemens, pour les transmettre à la postérité. DICTYS de Crète et DARÈS de Phrygie publierent, dit-on, les premiers, la relation de cette guerre, dont ils avoient été les acteurs, et les témoins.

BIENTÔT les guerriers qui avoient péri sous les murs de Troye, partagèrent les honneurs réservés aux dieux ; l'encens fuma sur le tombeau d'ACHILLE, et la plaine de Troye devint un vaste temple, où les voyageurs de toutes les nations, se faisoient un devoir religieux, d'offrir un sacrifice avant d'entrer dans l'Hellespont.

IL me semble voir le grand HOMERE, abordant pour la première fois sur ces rivages fameux, et rendant à l'ombre d'ACHILLE le plus digne hommage qu'elle ait jamais reçu ; je le vois marchant d'un air grave et pensif, entre les rives du Simois et du Scamandre : Son œil brulant embrasé avec avidité tous les objets qui l'entourent ; mille souvenirs se présentent à la fois à sa mémoire ; son cœur s'attendrit ; son imagination s'enflamme ; le plan de l'Iliade est formé !

*Ut Ducus implevit visus veneranda vetuſtas— **

HÉRODOTE est, je pense, après HOMERE, le plus ancien auteur qui nous ait parlé de la Troade. Suivant lui, la plaine, et les environs de Troye, après la guerre, fut long tems un sujet de discorde, entre les Athéniens et les Mitylénéens. Ceux-ci soutenoient que leur droits à la possession de la Troade n'étoient pas moins fondés que ceux des autres Grecs, qui avoient contribué, avec MÉNÉLAUS, à arracher HÉLÉNE de la main des Troyens.

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* LUCAN. Pharf. Lib. ix. 987.

JE n'ai point d'épreuve, que ce père des historiens ait fait le voyage de Troye ; mais j'ose au moins assurer, que la description qu'il donne de la marche de XERXÈS, est parfaitement d'accord avec ma carte. " L'armée de XERXÈS, (dit-il), en " quittant la Lydie, marcha vers le fleuve Caicus, et la Mysie. " Laissant ensuite le mont Cana sur la gauche, elle avança du " Caicus par Atarné, vers la ville de Carina. De-là, elle con- " tinua sa marche à travers la plaine de Thébé, et passa par la " ville Adramythium, et d'Antandros ; dirigeant ensuite ses pas " vers la partie gauche du mont Ida, elle entra dans le territoire " des Troyens. Pendant qu'elle étoit campée au pied de cette " montagne, un orage affreux, qui s'éleva pendant la nuit, fit " périr un nombre considérable de soldats. Quand l'armée " arriva au Scamandre, ce fut la première rivière qu'elle ren- " contra depuis Sardes, dont les eaux ne suffirent pas pour les " hommes et les chevaux. XERXÈS monta sur la Citadelle de " Troye, àfin d'observer la situation de la place, et s'informer " des particularités qui y avoient rapport. Il sacrifia mille beufs " à Minerve Iliade, et les Mages offrirent des libations aux hé- " ros. Dans la nuit qui suivit ces cérémonies, une alarme " s'étant repandue dans le camp, aussitôt que le jour vint à pa- " roître, l'armée se mit en marche, ayant à gauche les villes de " Rhetée, d'Ophrynéum, et Dardanus voisine d'Abydos ; et à la " droite le pays des Gergithes-Troyens."

L'ORATEUR ESCHINES fut conduit à Troye par la simple curiosité, et pour y rechercher les monumens mentionnés dans l'Iliade. Il avoit pour compagnon de voyage un jeune homme dont la conduite légère et imprudente l'empêcha d'exécuter son projet, et l'exposa même aux plus grands dangers. L'aventure qui les obligea tous deux de quitter la Troade avec la plus grande précipitation est véritablement déplorable. Elle est racontée en détail par ESCHINES lui-même dans la dixième des lettres attribuées à cet orateur*.

" ALEXANDRE,

* Vid. Oratores Græci, Edit. Reiske, Vol. iii. p. 679.

" ALEXANDRE, (d'après les differens auteurs dont le témoignage a été recueilli par FREINSHEMIUS dans son supplément à QUINTE CURCE), arrivé à Sestos, envoya la plus grande partie de ses troupes à Abydos, de l'autre côté du rivage, sous la conduite de PARMENION, et il lui donna cent soixante vaisseaux de guerre, et plusieurs autres de charge. Quant à lui, il alla avec le reste à Eléonte, qui est consacrée à PROTÉSILAUS, de qui l'on voit la sépulture, sous un petit tertre, environné d'ormes d'une nature merveilleuse ; car les feuilles qui naissent aux branches tournées du côté de Troye tombent en même tems qu'elles sont ouvertes, bienque toutes les autres conservent leur verdure, comme pour faire souvenir de la funeste avanture de ce héros, qui passa en Asie avec les Grecs dans une florissante jeunesse, et qui fut la première victime de la guerre des Troyens. Au reste, ALEXANDRE lui fit des sacrifices mortuaires, et le pria de permettre qu'il entrât dans une terre ennemie, sous des auspices plus heureux qu'il n'y étoit entré lui-même. De-là, il se rendit avec soixante vaisseaux à Sigée, et vit ce port qui fut mis en réputation par les Grecs, dont il avoit reçu la flotte du tems de la guerre de Troye. Comme il voguoit déjà au milieu de l'Héllespont, étant lui-même le pilote du vaisseau que le portoit, il immola un taureau à Neptune et aux Neréides, et pour faire une offrande aux dieux marins, il jeta dans la mer le vase d'or dont il avoit fait les libations. Lorsqu'il fut arrivé au port, il lança un dard sur le rivage, et sauta le premier à terre, prenant les dieux à témoins qu'il ne vouloit avoir l'Asie que par une guerre légitime. Ensuite il fit éllever des autels en l'honneur de JUPITER Défenseur, de MINERVE et d'HERCULE, au même lieu où il étoit descendu à terre, et commanda que l'on en dressât aussi à l'endroit où il étoit parti de l'Europe.

" AINSI il prit son chemin par la campagne, où l'on voit encore des marques de l'ancienne ville de Troye. Il y con-

“ fidéra curieusement les restes de tant d’ouvrages héroïques ;
 “ et lorsque quelqu’un des habitans lui eut offert la lyre de
 “ PARIS, il répondit, qu’il ne faisoit grand cas de cet instrument
 “ de lâches et molles voluptés, mais qu’on lui feroit plaisir de lui
 “ donner la lyre d’ACHILLE, sur laquelle il faisoit résonner les lou-
 “ anges des grands hommes, avec la même main dont il surpajoit
 “ leurs actions.

“ De plus, comme il avoit une admiration particulière pour
 “ ACHILLE, de qui il se glorifioit d’être descendu, il courut
 “ tout nud avec ses favoris à l’entour de son sépulcre ; il l’oig-
 “ nit d’huile, et mit dessus une couronne. EPHESTION cou-
 “ ronna aussi la sépulture de PATROCLE, pour témoigner qu’il
 “ avoit la même place dans l’amitié d’ALEXANDRE que PA-
 “ TROCLE dans celle d’ACHILLE. Au reste, parmi les discours
 “ qu’ALEXANDRE fit d’ACHILLE, il dit : Qu'il l'estimoit dou-
 “ blement heureux d'avoir eu, durant sa vie, un véritable et fidèle ami,
 “ et d'avoir trouvé, après sa mort, un excellent poète pour célébrer ses
 “ louanges. Il fit aussi des sacrifices à tous les autres héros,
 “ dont on voyoit les tombeaux dans cette contrée *.”

LORSQUE les Romains passèrent la première fois en Asie, pour chasser ANTIOCHUS du pays qu’il occupoit en deçà de mont Taurus, ils ne furent pas insensibles aux charmes du pais dont leurs souverains prétendoient tirer leur origine. Mais le cruel FIMBRIA montra des dispositions opposées à celles de ses concitoyens. Ayant pris le commandement de l’armée, après la mort du consul VALERIUS FLACCUS, qu’il avoit fait périr en Bithynie, il s’avança vers Ilium. Les Troyens à son approche, fermèrent les portes de leur ville, et envoyèrent, en même tems des députés à SYLLA, en lui proposant de se rendre à lui. SYLLA leur conseilla de se soumettre à leur vainqueur FIMBRIA ; il leur promit de venir bientôt à leur secours ; et leur rappela, pour les encourager, que les Romains tiroient leur origine des Troyens :

* Supplement. in Q. CURTIUM, Lib. ii. cap. 3.

Troyens : En même tems il envoya des députés à FIMBRIA pour l'engager à traiter les Troyens avec douceur. L'orgueilleux FIMBRIA piqué de cet ordre, assiégea, sur le champ, la ville ; et après s'en être rendu maître, dans l'espace de onze jours, comme il se vantoit en présence d'un Troyen de s'être emparé dans si peu de tems d'une ville qu'AGAMEMNON, avec mille vaisseaux, n'avoit pris qu'après dix ans de siège ; " il est vrai," répondit le Troyen, " mais nous n'avions pas un HECTOR " pour nous défendre." FIMBRIA rasa la ville, et massacra tous ses habitans. SYLLA ayant fait sa paix avec MITHRIDATE, fit marcher son armée contre FIMBRIA, qui, réduit à une situation désespérée, se donna la mort. SYLLA fit tous ses efforts pour apporter quelques consolations aux malheureux Troyens, et leur donna toute sorte de marques d'interêt et de bienveillance.

CÉSAR digne rival d'ALEXANDRE, et qui l'imita même jusque dans sa passion pour HOMERE, voulut renouveler l'alliance qui l'unissoit avec les Troyens. Il leur accorda de nombreux priviléges, et les combla de bienfaits. S'il en faut croire l'auteur de la Pharsale, ce guerrier poursuivant POMPÉE pénétra dans la Troade pour en visiter les monumens :

*Sigeasque petit famæ mirator arenas
Et Simoentis aquas, et Graio nobile busto
Rbaetion, et multum' debentes vatibus umbras *.*

POMPÉE enleva la statue d'AJAX, qui étoit dans le temple élevé près de son tombeau, et la transporta en Egypte. AUGUSTE la fit restituer aux Troyens dans la suite. JULIE, fille de cette Empereur, manqua, dit-on d'être noyée dans le Scamandre, en parcourant la plaine de Troye : AGRIPPA son époux se montra fort sensible à cet accident, et en témoigna son indignation aux Troyens comme s'ils avoient pu en être responsables.

Tous

* LUCAN. Lib. ix. 961.

Tous ces illustres voyageurs ne nous ont rien appris de la Troade, si non que ses monumens attiroient, encore de leurs tems, la curiosité des plus grands personages. Du reste, les princes, et les femmes d'alors voyageoient comme aujourd'hui, par ambition, par vanité, ou pour se dérober à l'ennui. ALEXANDRE honoroit ACHILLE, pour établir sa parenté avec ce héros, et faire accroire qu'il avoit hérité de son courage. La maison de JULES exemptoit les Troyens d'impôts, pour rappeler qu'elle étoit issue de celle de PRIAM ; et lorsque l'infame JULIE les fit accabler d'une injuste amende, c'est, sans doute, parcequ'elle ne reçut pas des Troyens les honneurs qu'elle se croyoit en droit d'en attendre. Revenons aux voyageurs éclairés dont les journaux ont triomphé des siècles pour arriver jusqu'à nous.

C'EST une chose bien étrange, que les deux plus grands géographes de l'antiquité, PAUSANIAS et STRABON ne soient jamais allés dans la Troade. Le premier en parle sur le rapport d'un certain Myrien, qui lui racontoit des prodiges touchant le tombeau d'AJAX ; le second s'appuye sur le témoignage d'un certain DEMETRIUS de Scepsis, auquel il ne paroît pas avoir une grande confiance ; qu'il accuse de contradiction ; qu'il ne trouve point d'accord avec HOMERE ; mais dont il a cependant adopté la description, sans doute, parcequ'il n'a pas pu s'en procurer de plus exacte.

IL ne m'a pas été possible de suivre plus avant dans l'histoire ancienne, les monumens, et les fleuves de la Troade. Je laisse aux érudits le soin de continuer ces recherches, et de remplir, s'ils le peuvent, par de nouveaux témoignages, l'immense lacune que la barbarie du bas Empire semble avoir laissée, entre le dernier des auteurs anciens qui a parlé de la Troade, et le premier des voyageurs modernes. Je ne serois point, au reste, étonné qu'après l'établissement du Christianisme, les temples et les tombeaux des guerriers ne soient tombés dans l'oubli : Ils ont du cesser d'attirer l'hommage comme les autels d'un culte sacrilége.

lége. Tout le monde fait avec quel zèle CLEMENT d'Alexandrie s'éleva contre cette espece d'idolatrie, et avec quelle véhémence il reprochoit aux nouveaux Chrétiens de prodiguer à ces nombreux tombeaux un encens qui n'étoit du qu'à la Divinité *.

MAIS pourquoi les prêtres du bas Empire n'ont-ils pas renversé ces monumens? Pourquoi n'en ont-ils pas effacé jusqu'à la trace? C'est qu'ils connoissoient la vénération des Grecs pour les sépultures, et c'auroit été peut-être le plus sûr moyen de les ramener à leur ancien culte, et de les détourner du nouveau, que d'osier porter la main sur les tombeaux de leurs guerriers.

Les Turcs devenus maîtres de la Troade, par la destruction et la conquête de l'empire, portent peut-être plus loin le respect pour les morts que les Grecs dont ils ont triomphé. Le prétexte de la commodité publique ou particulière, ne suffit pas chez eux, comme chez nous, pour violer les tombeaux; malheur à celui qui se rendroit coupable de cette profanation! Aussi s'opposent-ils avec la plus grande vigilance aux entreprises des étrangers curieux, qui cherchent à sonder ces monticules sacrés, dont la tradition leur a fait connoître l'usage, et auxquels ils ont conservé le même nom qu'on leur donnoit dans la plus haute antiquité.

LE Docteur POCOCKE est, je crois, le premier des modernes qui ait pénétré dans la Troade, ou dumoins, qui en ait tenté la description. Cet article de son ouvrage, quoique rempli de fautes et d'obscurité, m'a cependant guidé très utilement dans mes recherches. Il avoit vu la plus grande partie des tombeaux; il avoit vu la vallée de Thymbra, et le fleuve Thymbrius; mais il ne leva pas la carte du pays; et trop scrupuleux admirateur de STRABON, il aimait mieux se laisser égarer par ce géographe, que de s'en rapporter à ses propres yeux, qui l'auroient probablement conduit à se trouver d'accord avec HOMERE, s'il avoit fidèlement observé la Nature. De son tems, au reste, il n'étoit peut-être pas facile, ni prudent, d'exposer des instrumens de

géometrie,

* Cohortatio ad Gentes, cap. iii.

géometrie, à la face des Turcs ; ils n'avoient pas encore connu le joug des Russes, et ils n'étoient pas aussi traitables qu'ils le sont aujourd'hui.

LE Docteur RICHARD CHANDLER, de l'université d'Oxford, membre de la Société des Antiquaires de Londres, parut, il y a quelques années, dans la Troade, à la suite de POCOCKE. La hardiesse, et la franchise avec laquelle ce savant et estimable voyageur parle des tombeaux d'ACHILLE et de PATROCLE, d'ANTILOQUE et d'ÆSYETÈS, contraste d'une manière frappante avec la timide circonspection de POCOCKE. " Ces monumens," dit celui-ci, " pourroient bien être de la plus haute antiquité ; le " grand est *peut-être* le tombeau d'ACHILLE et les deux autres " ceux de PATROCLE et d'ANTILOQUE."

" LES deux éminences," dit celui-là, " que j'apperçois dans " la vigne, sont les tombeaux d'ACHILLE et de PATROCLE ; le " troisième est celui d'ANTILOQUE fils de NESTOR ; je distingue " du côté opposé le tombeau d'AJAX, et à une plus grande di- " stance le tombeau d'ÆSYETÈS."

QUAND ON a lu l'ouvrage du Docteur CHANDLER, on ne fauroit le soupçonner d'avoir avancé légèrement son opinion sur les monumens dont il parle. Il a ses preuves, j'en suis sûr, mais je regrette véritablement qu'il ait paru mettre si peu d'importance à des objets qui demandoient la discussion la plus approfondie ; je le blâme d'avoir assez compté sur la crédulité de ses lecteurs, ou sur leur instruction, pour imaginer qu'ils adopteroient sur sa parole les prodiges qu'il leur annonce ; je le blâme enfin de ne s'être pas appuyé des conjectures de son célèbre compatriote. Au reste, je trouve dans la réunion de leurs respectables témoignages une autorité dont je vais m'armer avec confiance, et j'ose espérer avec succès, contre la défiance et l'incredulité.

J'AUROIS désiré de toute mon âme pouvoir aussi appeler à mon secours, les observations de Mr WOOD, le célèbre auteur du

du voyage de Palmyre, et de l'Essai sur le génie d'HOMERE ; mais je ne crains pas de le dire, Messieurs, parce que je le prouverai bientôt,—Mr WOOD s'est égaré dans la Troade.

C H A P. VII.

Erreur de Strabon sur le Scamandre.

STRABON ne pouvant parler de la Troade à ses lecteurs d'après ses propres observations, parce qu'il n'y étoit jamais allé, a cherché à s'appuyer de celles de quelque géographe éclairé. DEMETRIUS de Scepsis fut celui dont il adopta la description ; mais la manière dont il s'y prend pour inspirer aux autres de la confiance en cet auteur, semble prouver qu'il en avoit peu lui-même. " Il y a de la contradiction dans ceci," dit-il dans un endroit, " mais j'approuve le reste ; et je crois " que dans beaucoup de choses il faut s'en rapporter à DEMETRIUS de Scepsis, homme instruit, né sur les lieux, et qui " d'ailleurs a pris tant d'intérêt à la scène de l'Iliade, qu'il a " composé trente livres sur les soixante vers d'HOMERE qui ont " rapport à la plaine de Troye."—" Ecouteons," ajoute-t-il encore ailleurs, " DEMETRIUS de Scepsis, cet homme versé dans " la connoissance de la Troade, puisqu'il y est né ; il nous apprend que le Scamandre prend sa source dans le mont Cotylus, avec le Granique et l'Æsepus. Il avoue, de plus, que " le Scamandre coule vers l'occident, tandis que les deux autres coulent vers le nord."

AYANT une fois adopté la doctrine de cet observateur, STRABON doit maintenant chercher à l'accorder avec les poèmes d'HOMERE ; il en sent la nécessité, et il a la bonne foi de ne pas en dissimuler la difficulté. " Au reste," dit-il, " les vers suivans d'HOMERE fournissent matière à une grande discussion :

Κρενὰ δίκανον καλλιρρόω, ἐνθα δὲ πηγαὶ
 Δοιαὶ ἀναισσοστοι Σκαμάνδρος δινήεντος.
 "Η μὲν γὰρ θύδατι λιαρῷ ρέει, ἀμφὶ δὲ καπνὸς
 Γίνεται ἐξ αὐτῆς, ὥστε πυρὸς ἀιδομένοιο"
 "Η δὲ τέρπη θερεῖ προρέει εἰκυῖα χαλάζῃ,
 "Η χιόνι ψυχερῇ, η ἐξ θύδατος κρυσάλλῳ*.

" Ils arriverent enfin aux deux belles sources, je veux dire, à l'endroit où jaillissent les deux sources du Scamandre ; car cette rivière a deux sources : L'une est chaude, et il s'en élève de la fumée, comme autour de la flamme : L'autre, en été, est froide comme la grêle, la neige, ou la glace transparente." " Ceci," dit STRABON, " présente une difficulté. On ne trouve point de sources chaudes dans cet endroit ; et la source du Scamandre n'est pas là, mais dans la montagne. D'ailleurs il n'y en a pas deux ; il n'y en a qu'une. Il est donc probable que la source chaude a disparu, mais que la source froide s'échappant du Scamandre par un passage souterrain, paroît près de là ; ou bien l'on peut imaginer en core, que ce courant d'eau a été appelé la source du Scamandre, parce qu'il est voisin de ce fleuve ; c'est en effet, de cette manière, que l'on peut dire qu'une rivière a plusieurs sources."

CETTE application est si miserable, si obscure, si inintelligible, qu'on ne fait lequel on doit blâmer le plus, de DEMETRIUS de Scepsis, qui commet une erreur grossière, ou de STRABON qui cherche à la consacrer.

LE

* Iliad. xxii. 147.

LE mont Cotylus, où DEMETRIUS place la source du Scamandre, au lieu de celle du Simois, est à quinze lieues du rivage de la mer. C'est le Kas-dahi, ou *la montagne de l'Oie*, dont j'ai fait la description dans mon journal. Il est, après le mont Gargara, le sommet le plus élevé de la chaîne de l'Ida, peuplé de *bêtes fauves*, comme au tems d'HOMERE, et environné d'autres montagnes, dont les rameaux s'étendent à l'ouest jusqu'à la mer, et à l'est vers la Mytie. L'armée Grecque n'a jamais pu faire la guerre au milieu de ces impraticables montagnes. Ainsi, d'après STRABON, ou plutôt d'après DEMETRIUS, il faut supposer qu'HOMERE nous a trompé, quand il nous a dit que les plus grandes batailles se donnoient entre les rives des deux fleuves ; que la ville de Troye étoit située près des sources du Scamandre, et que le Grecs alloient souvent dans le même jour jusqu'au pied des murailles, et revenoient à leur camp.

J'AUROIS pu me dispenser d'entrer dans ces détails, et de m'étendre si au long sur la réfutation de STRABON, il me suffissoit de me trouver d'accord avec HOMERE, de prouver que les sources du Scamandre sont encore aujourd'hui dans la plaine de Troye, à l'endroit où elles doivent être pour satisfaire à tous les incidebs de l'Illiade, et que le fleuve qu'elles forment, a tous les caractères que le poëte lui donne. Mais après avoir exposé quelques unes des erreurs dans lequel STRABON est tombé, en accordant sa confiance à DEMETRIUS, je rendrai maintenant justice à certaines parties de sa description que j'ai trouvées exactes ; car quoique cet auteur justement célèbre, ne reconnoisse pas les sources du Scamandre, et les rejette à dix lieues de la plaine où elles sont à présent, et où elles étoient indubitablement de son tems, il n'en a pas moins montré une connoissance suffisante de son sujet dans beaucoup d'autres points.

C H A P. VIII.

Examen de quelques passages de Strabon.

IL suffit de jeter les yeux sur la carte de la plaine de Troye pour reconnoître aussitôt combien cette carte est d'accord avec la description de STRABON, qui, quoique exacte à beaucoup d'égards, ne fauroit cependant paroître intelligible dans bien des cas, aux yeux mêmes de ses plus zélés admirateurs.

“ DANS cet endroit,” dit-il avec DEMETRIUS, “ deux chaînes de montagnes recourbées se détachent de la grande chaîne de l’Ida, et s’étendent vers la mer, l’une dans la direction du Cap Sigée, et l’autre dans celle du Cap Rhétée. Chacune d’elles forme une ligne semicirculaire, et elles se terminent, l’une et l’autre, dans la plaine, à la même distance de la mer que la nouvelle Ilium. Cette ville est, en effet, située dans l’espace qui s’étend entre les extrémités de ces collines, comme l’ancienne Troye l’étoit entre leur origine. Elles comprennent dans leurs enceintes, la plaine du Simois, arrosée par ce fleuve, et celle du Scamandre. Ces deux parties forment un ensemble, qui est encore appelé la plaine de Troye, et qui fut, suivant le poète, le théâtre du plus grand nombre des combats. Le bois des figuiers sauvages, le tombeau d’ÆSYTÈS, Batieia, le monument d’Ilius, le Scamandre, et le Simois, qui coulans l’un du côté du Cap Sigée, l’autre du côté du Cap Rhétée se réunissent, en face, et à une petite distance de la nouvelle Ilium, se jettent ensuite dans la mer près du Cap Sigée, et forment, avant de s’y jette, un marais, appelé *Stoma Limné*, *le marais de l’embouchure* *.”

JUSQU’ICI

* Geograph. p. 892. Edit. Amst. 1707.

JUSQ'ici STRABON n'auroit pas été plus exact quand il auroit eu la carte sous les yeux. La plaine où est située le village de Bounarbachi est, en effet, bordée de deux collines, à peu près semicirculaires, qui se dirigent, l'une vers le Sigée, et l'autre vers le Rhetée. On y retrouve encore aujourd'hui la plus grande partie des objets mentionnés par le poète : La colline des figuiers sauvages, le tombeau d'ÆSYTÈS, le monument d'ILUS, le Scamandre, dont le cours est dirigé vers le Sigée, comme celui de Simpis vers le Rhetée. Ces deux fleuves, qui se réunissoient autrefois, et alloient se jettter dans la mer près du Cap Sigée, en formant un marais qu'on voit encore aujourd'hui, à leur embouchure, ne se réunissent plus. Le Scamandre, comme on peut le remarquer dans la carte, suit une direction nouvelle. Les figuiers sauvages ne croissent plus dans les environs de Bounarbachi ; mais on en trouve par tout ailleurs, dans la plaine, et sur les montagnes voisines. Batieia, où le tombeau de MYRINNE, n'a point résisté aux injures du temps ; mais sa situation est une conséquence évidente des objets connus qui l'environnoient.

" VIENT ensuite," continue STRABON, " la ville de Rhetée, située sur une éminence, près de laquelle s'étend une plage sableuse, où se trouve Aiantéum, c'est à dire, le tombeau " et le Temple d'AJAX, avec sa statue *."

L'ORIGINAL est encore ici un peu obscur et confus, mais autant qu'on y peut trouver un sens, il s'accorde en général avec la carte.

" LA longueur de la côte, qui s'étend entre le Cap Rhétée " et le Cap Sigée, où est le tombeau d'ACHILLE, est de soixante " stades en ligne droite ; elle se prolonge au dessous de la nouvelle Ilium, dont la distance au port des Grecs est d'environ " douze stades †."

LA distance entre ces deux Caps, fixée géométriquement, est, à peu près, moindre de moitié que celle que STRABON donne ici ;

* P. 890.

† Ibidem.

ici ; mais parfaitement d'accord avec celle que PLINE le Naturaliste assigne *. Quant à celle de la nouvelle Ilium au port des Grecs, ou à la mer, quel fond pouvons nous faire sur l'exactitude de STRABON, qui d'abord la fixe à douze stades, et deux pages après la porte jusqu'à vingt ?

“ UN peu au dessus est situé le *village des Troyens*, où l'on croit qu'étoit autrefois l'ancienne Ilium, à la distance de trente stades de la nouvelle ; et dix stades au dessus du village des Troyens, est la belle *Coloné*, espece d'éminence de cinq stades d'étendue, au pied de laquelle coule le Simois †.”

IL y a encore ici quelques traits de ressemblance, entre la description de STRABON et notre carte ; mais après l'échantillon d'inexactitude que nous venons de remarquer dans ses mesures précédentes, nous serons excusables de ne pas faire plus de fonds sur celles-ci. Les agréables collines qui s'étendent entre les villages de *Tchiblak* et *Aktcbé*, sur les bords du Simois sont nécessairement la belle Coloné, de haut de laquelle MARS, semblable à une tempête, encourageoit les Troyens à grands cris ‡. STRABON les place à quarante stades au dessus de la nouvelle Ilium, et nous apprend qu'elles s'étendoient à cinq stades le long des bords du Simois. A mesure, en effet, qu'on s'éloigne du village de Tchiblak, qui se trouve à peu près à quarante stades de l'ancienne Ilium, leurs sommets couverts de gazon, perdent leur forme moelleuse et adoucie, et deviennent arides, rocheux et escarpés. Quant au village des Troyens, *Iliensis vicus*, qu'on croyoit occuper l'emplacement de l'ancienne Troye, STRABON ne put pas être foupçonné d'avoir voulu adopter cette croyance, puisqu'il a commencé par dire, que l'ancienne Troye étoit à l'endroit d'où partent les deux collines semicirculaires.

“ LA vallée de Thymbra n'est pas éloignée de l'ancienne Ilium ; elle est arrosée par le Thymbricus, qui se jette dans “ le

* Nat. Hist. lib. v. c. 33.

‡ Iliad. xx. 50.

† P. 892. *ad finem.*

" le Scamandre. Le temple d'APOLLON est situé sur les bords
" de ce premier fleuve*."

L'OUVERTURE de la vallée de Thymbra se trouvoit entre la nouvelle et l'ancienne Ilium. Elle étoit, quoique STRABON puisse ou veuille en dire, (car il n'est pas encore aisé de la deviner ici), elle étoit, dis-je, plus voisine de la première de ces villes que de la seconde. Le fleuve Thymbrius, après l'avoir arrosée, alloit autrefois se jettter dans les bras de la rivière formée par la réunion des deux fleuves, et que STRABON appelle Scamandre, sans doute, parceque le Simois étant presque toujours à sec, on conservoit aux deux fleuves réunis, le nom de celui qui portoit à la mer le tribut le plus constant de ses eaux. L'embouchure du Thymbrius n'a point changé de place ; mais le Simois seul reçoit ce fleuve, depuis que le Scamandre en est séparé. Les ruines du temple d'APOLLON se voyent encore, dans la vallée de Thymbra, sur les bords du Thymbrius, près du village de Halil-eli.

" LE monument que l'on montre comme le tombeau d'AESY-
" ETÈS, est près de la route qui conduit d'Ilium recens à Alex-
" dia Troas †."

ENVIRON un mille au dessus d'Erkeffighi, on voit encore ce grand tombeau. Il est en effet, près de la route qui conduisoit autrefois de la nouvelle Ilium à Alexandria Troas. Il est même impossible, à cause des montagnes, d'aller de Bounar-bachi à Alexandrie, sans passer près de ce monument, ainsi il se trouvoit également sur la route de la nouvelle et de l'ancienne Troye à Alexandrie.

" CETTE partie de la plaine qui s'enfonce dans la montagne
" est étroite ; elle s'étend en partie vers le midi, jusqu'aux en-
" viros de Scepfis, en partie vers le nord jusqu'à Zéléia, ville
" des Lyciens ‡."

ON

* STRABO, p. 893.

‡ P. 891.

† P. 895.

ON reconnoit ici clairement ce vallon étroit, et bordé de précipices, où coule le Simois, et qui s'étend vers le sud, depuis la plaine de Bounarbachi, dont il n'est qu'une continuation, jusqu'à celle d'Ené, voisine d'*Ejki-kuptcbu*, l'ancienne *Scepsis*: On voit aussi, que cette seconde plaine, prend à Ené une direction qui s'éloigne du sud; mais les bornes de la carte n'ont pas permis qu'on la représentât dans toute son étendue, c'est à dire, jusqu'au Cotylus, et à l'ancien pays des Lyciens, qui se trouvent, en effet, au nord.

La plaine de Troye n'a donc point changé de face depuis STRABON. J'étois suffisamment autorisé à placer l'ancienne Troye à l'origine des collines, et la nouvelle à leur extrémité; et ce géographe ne pouvoit m'accuser d'infidélité, dans des positions aussi clairement désignées par lui-même. Des recherches particulières m'ont fait découvrir l'emplacement de ces deux villes; ainsi il sera déformais inutile de recourir avec Mr Wood aux tremblemens de terre, dont rien n'offre la trace dans la plaine de Troye, et dont tout, au contraire, démontre la fausseté, pour expliquer la disparition, ou la destruction des monumens, des fleuves, et des vallées, qu'on retrouve encore dans le lieu même où HOMERE les a vus, et où STRABON n'auroit pas manqué de les trouver lui-même, si, au lieu de s'en rapporter à l'autorité de DEMETRIUS de Scepsis, il avoit pris la peine de se transporter dans la Troade.

IL est surprenant que le Docteur CHANDLER ait cru nécessaire d'informer son lecteur, que le Simois avoit été confondu avec le Scamandre, et soit, en même tems, tombé dans l'erreur qu'il cherche à corriger, en avançant, que le Simois étoit la rivière la plus voisine du Cap Sigée et du Lectos; tandis qu'il auroit du dire cela du Scamandre.

HOMERE, plus exact que tous les voyageurs qui l'ont suivi dans la plaine de Troye, indique la situation relative du Scamandre, avec la plus grande précision et la plus grande exactitude, quand il dit:

Πεύθε· ιτις πα μάχης ιτ' αριστερὰ μάχην τωνος.
Οχθας πορε ποταμοῦ Σκαμανδρου·

"Et HECTOR ne favoit pas ce qui se passoit, parcequ'il
"battoit à la gauche de l'armée (des Troyens), sur les rives du
"Scamandre."

C H A P. IX.

Examen de la carte de la Plaine de Troye par Pope.

LA critique amère que Mr WOOD fait de la carte, qu'on voit à la tête de la traduction de l'Iliade, par le célèbre POPE, m'a inspiré la curiosité d'examiner cette carte, et de la comparer avec la mienne†. A la seule manière dont elle est désignée, il est aisé de juger, qu'elle n'est pas l'ouvrage d'un géographe ; car les objets n'y sont pas représentés suivant la convention à vol d'oiseau, mais en perspective, comme dans un tableau de paysage. Cette faute est de peu de conséquence aux yeux des littératoirs, et je pardonnerois à POPE lui-même de l'avoir commise, pourvu que son mauvais dessin fut exact, et qu'on put y appliquer les différentes circonstances de la guerre de Troye, dont il donne la description la plus complète, et la plus détaillée ; mais cette carte offre des erreurs si extraordinaires, que j'ai d'abord été tenté de croire, qu'elles ne pouvoient provenir que de la mal-adresse du graveur, qui a trans-

VOL. III. au dessus cette partie de la page n'a rien de porté

* Iliad. xi. 497.

† Voyez An Essay on the original Genius and Writings of Homer, p. 87.

porté sur la droite les objets destinés à occuper la gauche. En effet, comment put-on supposer que POPE ait placé le Cap Sigée à la gauche du camp des Grecs ?

LES erreurs au sujet du tombeau d'ÆSYTÈS, et de celui d'ILUS sont moins choquantes, et plus pardonnables que la précédente. Il a placé le premier de ces tombeaux entre les deux fleuves, sur la rive gauche du Scamandre, tandis qu'il se trouve sur la droite ; mais le poète s'étoit contenté d'indiquer ce tombeau comme l'endroit le plus avantageux que POLITÈS, fils de PRIAM, put choisir pour observer les mouvements des Grecs * ; il n'avoit pas porté le scrupule jusqu'à désigner le point mathématique où il étoit situé.

QUANT à la position du tombeau d'ILUS, POPE a évidemment mal compris le sens d'HOMÈRE, en la plaçant à moitié chemin du camp des Grecs et de la ville de Troye ; ce n'est pas là ce qu'HOMÈRE a voulu dire, en nous apprenant, que le tombeau d'ILUS étoit au milieu de la plaine : STRABON nous explique sa pensée, quand il nous dit, qu'ILUS fut enterré au milieu de la plaine, parce qu'il avoit osé l'habiter le premier †.

Du reste, il a parfaitement deviné la situation du camp des Grecs, entre les deux caps ; la réunion des deux fleuves, à peu de distance des vaisseaux ; la forme générale de la plaine ; le cours du Simois, plus étendu que celui du Scamandre ; la juste distance de la ville à la mer ; le voisinage de la même ville, et des deux sources du Scamandre : Mais quel motif peut l'avoir déterminé à les placer du côté opposé à celui où elles se trouvent dans la nature ? J'y ai réfléchi long temps, et avec d'autant plus d'intérêt, que parmi tous les auteurs qui ont écrit sur la Troade, il en est peu qui m'en imposent plus que POPE.

Ne pourroit-on pas supposer, que ce grand homme, ayant découvert dans quelque passage de l'Iliade, que les sources du Scamandre étoient au couchant ; accoutumé d'ailleurs à regarder, suivant l'usage reçu, la gauche d'une carte comme le couchant, ait,

* Iliad. ii. 791.

† STRABO, p. 886. Edit. Amst. 1707.

ait, à défaut de connoître les petites ressources de la géographie, sacrifié toutes ses autres positions, telles que celles du Cap Sigée, du Simois, &c. à l'impérieuse loi d'être fidèle à son original ? C'est ainsi, si l'on me pardonne de supposer qu'un très grand poète puisse être un médiocre géographe, c'est ainsi dis-je, qu'il faut rendre compte des défauts de cette carte, qui, avec toutes ses imperfections, a dû coûter à POPE, infiniment de peine, et exiger de sa part de grandes combinaisons. Je ne vois, du moins, que ce moyen, d'expliquer comment le même homme peut produire une carte aussi défectueuse, à l'appui de l'essai le plus complet, et le plus exact, sur les batailles d'HOMERE.

J'AI été tellement enchanté, Messieurs, de la précision avec laquelle cet essai s'accorde avec ma carte, que j'ai cru devoir le mettre sous vos yeux, à fin d'augmenter votre confiance dans mes travaux, par une autorité d'un grand poids parmi vous, et dans le reste du monde savant.

" L'ANCIENNE ville de Troye étoit," dit il *, " à une plus grande distance de la mer que les ruines d'Alexandria Troas, " qu'on a mal-à-propos confondues avec les siennes. Les " Troyens, en effet, n'osèrent combattre hors de leurs murailles, " qu'après la retraite d'ACHILLE ; mais dans la suite ils atta- " querent les Grecs, jusqu'à près de leurs vaisseaux, très éloig- " nés de la ville. D'ailleurs, comme observe STRABON, si cette " ville avoit été voisine du rivage, il y auroit eu de la folie, et " de l'imprudence de la part des Grecs, à attendre la dixième " année du siège, pour fortifier leur camp, contre un ennemi " qui les auroit menacés de si près ; et il y auroit eu de la " lâcheté de la part des Troyens, à rester si long temps dans l'in- " action, et à rien tenter contre une armée sans retranchemens †. " De plus, dans la supposition où la ville eut été près du rivage,

* Voyez l'Essai au commencement du liv. v. de sa traduction de l'Iliade.

† STRABO, p. 893. Edit. Amst. 1707.

" l'espace intermédiaire n'auroit pas été suffisant pour les combats, et les événemens dont il a été le théâtre."

" Les lieux les plus remarquables autour de Troye," continue toujours POPE, " étoient : 1. *Les portes Scées.* Elles s'ouvroient sur le champ de bataille, et c'étoit par là que sortoient les Troyens, lorsqu'ils alloient au combat. Tout près de ces portes étoit le *chêne, consacré à Jupiter.* 2. La colline des *figuiers sauvages*, ou l'*Erineos.* Elle étoit adjacente aux murailles de la ville, puisqu' ANDROMAQUE cherche à diriger l'attention d'*HECTOR* du côté de cette colline, comme étant le seul endroit par où l'ennemi pouvoit escalader la ville *. Il paroît qu'elle s'étendoit jusqu'au grand chemin ; car dans la course d'*HECTOR* et d'*ACHILLE*, ces deux guerriers, après avoir passé la colline des figuiers, parvinrent à la grande route †. 3. *Les deux sources du Scamandre,* étoient un peu plus loin, sur la même direction ‡. En effet, les deux guerriers après avoir traversé la colline des figuiers, et la route publique, s'arrêtent près de ces sources. 4. *Callicoloné* étoit le nom d'une agréable colline, qui s'étendoit sur le bords du Simois de l'autre côté de la ville ||. 5. *Baticeia,* où le tombeau de *MYRRINNE*, étoit en face de la ville, à peu de distance §. 6. Le monument d'*ILUS*, vers le milieu de la plaine **."

POPE, après nous avoir fait connostre la situation des principaux objets qui avoisinoient la ville, et qui étoient situés dans la plaine, nous trace celle des différens champs de bataille.

" IL paroît," dit-il, " par le quatre-cens soixante-septième vers du second livre de l'Illiade, que l'armée Greque, sous la conduite de différens chefs, étoit rangée sur les rives du Scamandre, du côté des vaisseaux ; pendant que celle de Troye et des

* Iliad. vi. 432.

|| Iliad. xx. 53.

† Ibid. xxii. 145.

§ Ibid. ii. 813.

‡ Ibid. xxii. 147.

** Ibid. xi. 166.

des auxiliaires, étoit vers le tombeau de MYRINNE*. Le premier champ de bataille, où DIOMÈDE fit de si grands exploits, étoit près de la réunion du Simois et du Scamandre ; car JUNON et PALLAS venant à lui, descendant au confluent des ces deux rivières †. Les Grecs, alors, n'avoient pas encore passé le Scamandre, puisque JUNON dit, que *les Troyens les bravent jusques près de leurs vaisseaux* ‡. Mais au commencement du sixième livre, les batailles se donnent entre les rives du Simois et du Scamandre.

ON se bat dans le huitième livre, près des retranchemens des Grecs sur le rivage de la mer ; et dans l'onzième livre, aux environs du tombeau d'ILUS : Dans le douzième, le treizième et quatorzième, près du retranchement des Grecs ; et dans le quinzième, aux vaisseaux.

DANS le seizeième, les Troyens étant repoussés par PATROCLE, le combat s'engage entre la flotte, la rivière, et les hautes murailles des Grecs ||. Dans le même livre, PATROCLE s'avancant de plus en plus, va combattre jusqu'aux portes de Troye §. Dans le dix-septième, on se dispute le corps de PATROCLE sous les murailles de Troye **. Dans le même livre, HECTOR et ENÉE poursuivent, jusques dans leurs retranchemens, les Grecs, qui emportent le corps de PATROCLE ††. Dans le dix-huitième, ACHILLE, venant à paroître, les Troyens se retirent, et placent leur camp en dehors des fortifications.

DANS le vingtième, on combattoit encore près de la mer ; puisque les Troyens poursuivis par ACHILLE, traversent le Scamandre, en fuyant vers leur ville ‡‡.

POPE paroit surpris de ce qu'HOMERE n'ait point exprimé de quelle manière les armées passoient le fleuve. La raison de

sort

* Iliad. ii. 815.

§ Iliad. xvi. 700.

† Ibid. v. 773.

** Ibid. xvii. 403.

‡ Ibid. 791.

†† Ibid. xvii. 760.

|| Ibid. xvi. 396.

‡‡ Ibid. xx. 1.

son silence, à cet égard, est bien simple ; c'est que le Scamandre est un ruisseau, qui a tout-au-plus, quinze pieds de large et trois pieds de profondeur. Il auroit du soupçonner cette raison, puisqu'il a très bien remarqué lui-même, que les batailles frivantes se donnaient *dans le fleuve*, ou sous les murs de la ville. Comment auroit-on pu se battre dans un fleuve qui auroit eu quelque profondeur ?

C H A P. X.

Examen de la même carte par Mr Wood.

LA certitude de notre propre supériorité, peut nous porter à négliger l'opinion et les travaux des autres. Ce sentiment, quoique peu modeste, provoque l'indulgence, quand il est couronné de succès ; mais quand, au mépris des guides, on vient à s'égarer, on perd dès lors tous les droits à la compassion, et l'on mérite toute la sévérité de la critique.

JE ne crains pas de le dire, Messieurs, parce que je vais le prouver, Mr Wood a mal vu la Troade. Cette partie de son essai sur HOMÈRE, n'est pas seulement imparfaite, elle est décidément mauvaise. Il n'est pas étonnant, au reste, qu'ayant pour but principal, de nous faire connoître les intéressantes ruines de Palmyre, et de Balbec, il n'ait pas pu donner à la plaine de Troye, le temps, et l'attention qu'elle méritoit. Ce n'étoit pas un crime à Mr Wood à l'omettre, mais c'en est un véritable, d'avoir mieux aimé la bouleverter, que de l'étudier avec l'ouvrage de POCOCKE à la main.

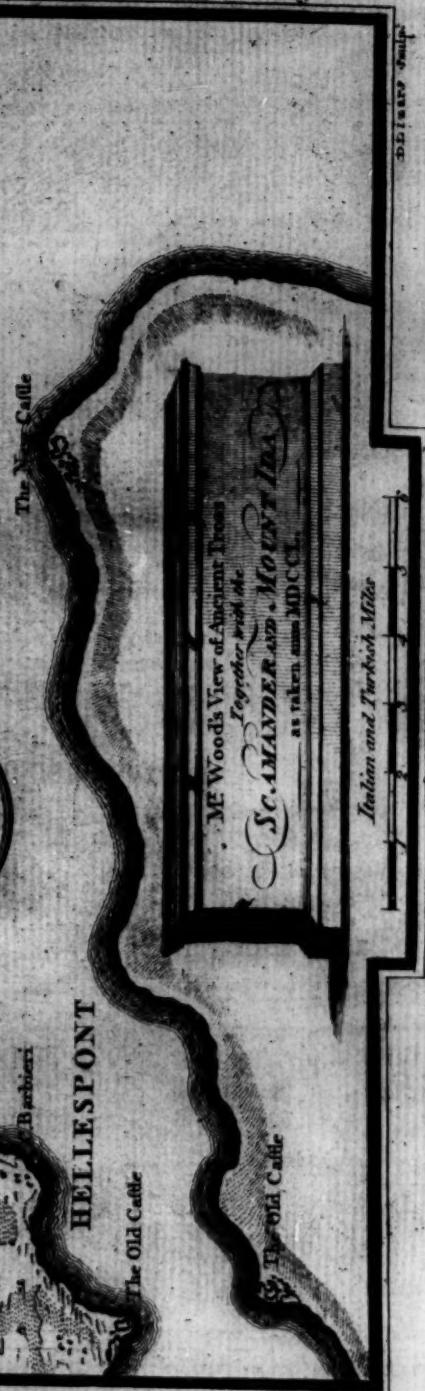
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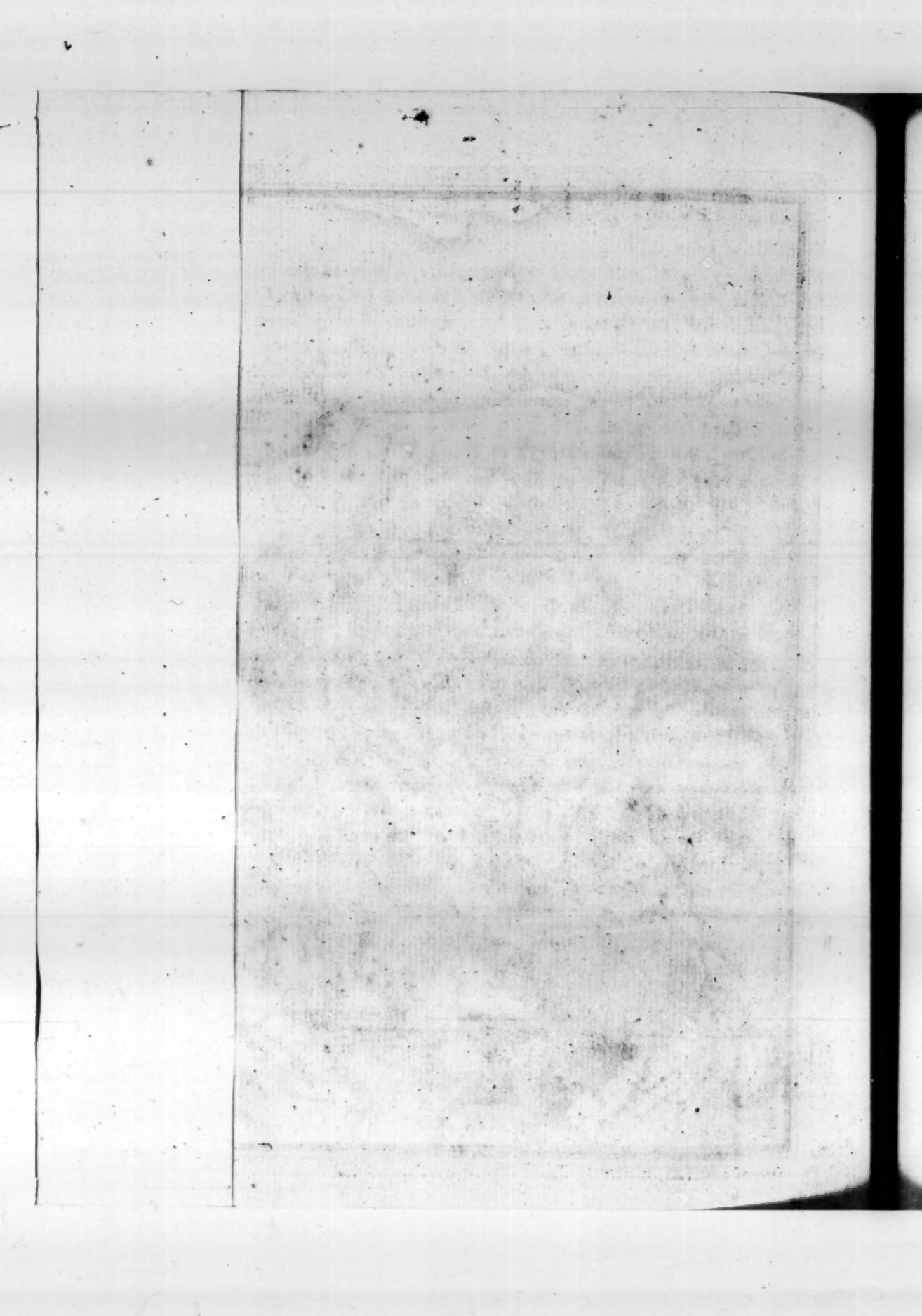




To face page 5d TAC

EGEA





SUIVONS cet homme célèbre. Vous allez être étonnés, Messieurs, de la peine qu'il se donne, pour découvrir la situation de l'ancienne Troye, et les sources du Scamandre, à plus de quinze lieues de la mer ; vous serez étonnés, qu'il ait vu le Scamandre*, qu'il l'ait dessiné sur sa carte, sans le reconnoître ; vous serez étonnés, qu'il ne fasse aucune mention de ces monumens extraordinaires, qui avoient au moins fixé l'attention de POCOCKE ; vous serez étonnés, de ne pas trouver une seule fois le nom de ce voyageur dans sa bouche.

" Si l'on examine ma carte de la Troade," dit Mr WOOD, " on ne la trouvera pas d'accord avec le pays que décrit HO-MERE †." Tant pis. Comment se fait-il que vous ayez trouvé ce grand poète partout d'accord avec la nature, et que vous le trouviez justement en faute, dans les lieux qu'il a du observer, et dépeindre avec le plus de soin ?

" CETTE différence," continue Mr WOOD, " vient d'un accroissement de terrain qui a augmenté la distance de Troye, à la mer †." Mais, de grâce, Mr WOOD, quelle preuve avez-vous, que la Troade s'est élargie de dix lieues ? Car il n'en faut pas moins, pour vous autoriser à placer la ville de Troye aux sources de ce torrent que vous appellez votre Scamandre.

DANS quelle partie de la Troade s'est fait cet accroissement, et quelle en a été la cause ? Est-ce le Simois qui a allongé la plaine, à force de charier des sables à son embouchure ? Il est aisé de mesurer la petite augmentation, qui en a résulté pour la plaine de Troye, entre les deux caps. Il est aisé même, de prouver, que cette augmentation ne put pas devenir plus considérable, parce que les impétueux courans de l'Hellespont s'y opposent sans cesse, et entraînent les sables dans la mer Egée, à mesure que le fleuve les accumule à son embouchure.

CE

* Description of the Troade, p. 326.

† Ibid. p. 329.

† Ibid. p. 328.

CE n'est donc pas à l'embouchure du Simois que l'accroissement de la Troade peut avoir eu lieu ; mais dans quel endroit de la côte s'est-il donc fait ? Les ruines d'Alexandrie se voient encore dans le lieu même où cette ville étoit autrefois située. Le haut promontoire de Sigée, forme encore avec la pointe de la chersonese l'entrée de l'Hellespont, comme au tems d'ACHILLE et d'HOMERE. Encore une fois, où s'est donc opéré cette prodigieuse révolution que Mr Wood appelle à son secours ?

" JE suis pareillement très sûr," dit ensuite Mr Wood, " que la situation du Scamandre est considérablement changée ; " et ce qui fond mon opinion à cet égard, c'est que cette rivière avoit une source chaude ; mais cette source est beaucoup plus bas que celle que nous avons découverte, et n'a point de communication avec le Scamandre."

IL ne faut que jeter un coup d'oeil sur la carte de Mr Wood, pour appercevoir, que c'est un ouvrage négligé, et fait à la hâte. On n'y voit ni villages, ni routes, ni monumens. Lorsque Mr Wood parle d'une source chaude *inferieure*, ce n'est pas de celle de Bounarbachî dont il prétend parler, puisqu'il ne l'a pas connue, c'est sans doute des sources thermales de Lidja, près d'Alexandrie *. En un mot, et pour ne point prolonger une critique inutile, à laquelle Mr Wood donne lieu dans tout le cours de sa description, voici, je pense, comment il a procédé dans ses observations, et comment il a été entraîné dans ses erreurs :

PERSUADÉ que le Simois se réunissoit au Scamandre, il a suivi le cours de ce premier fleuve, et il n'a rien trouvé jusqu'à Bounarbachî où la plaine se termine ; parceque le Scamandre avoit déjà, sans doute, été détourné de son ancien lit, et que Mr Wood n'aura pas été assez heureux pour appercevoir ce changement particulier, qui a été la véritable cause de mes principales découvertes.

IL a vu les sources de Bounarbachî ; mais soit qu'il les ait observées légèrement, soit qu'il les ait vues dans une saison, où il

* Voyez ci-devant, p. 8.

il y avoit peu de différence dans leur température, soit qu'il ait ignoré la langue Turque et Grecque, ou qu'il n'ait pu tirer aucun renseignement de l'Aga, et des habitans du village voisin, le fait est, qu'il n'a pas reconnu les véritables sources du Scamandre.

Du moment où il a été hors de la plaine, et qu'il s'est enfoncé dans les défilés et les montagnes de l'Ida, son erreur est devenue sans remède : Plus il s'est éloigné de la mer, plus les descriptions d'HOMERE sont devenues inexplicables pour lui. Tout autre à sa place, ou plus modeste, ou moins entêté, seroit revenu sur ses pas, ou, du moins, auroit abandonné la partie, en convenant qu'il n'avoit pas réussi. Mr WOOD est intrépide : Les difficultés rehaussent son courage : Il s'avance jusqu'à ce qu'il trouve un large torrent, qui à travers des montagnes impraticables vient se joindre au Simois près d'Iné. Voilà le Scamandre de Mr WOOD !

IL faut maintenant aller chercher la ville de Troye, jusqu'aux sources de ce torrent ; Mr WOOD ne perd pas courage ; il voit clairement qu'il est égaré, mais il ne veut pas sortir de la Troade sans l'avoir bouleversée. Il cherche un compagnon d'infortune, il le trouve dans STRABON, qui à la vérité s'est trompé comme lui ; mais ne s'est pas trompé sur les lieux, comme il l'en accuse ; car tout le monde sait, et Mr WOOD ne devroit pas l'ignoré, que ce géographe n'a parlé de la Troade que sur l'autorité de DEMETRIUS de Scepsis.

APRÈS avoir invoqué les tremblemens de terre, les convulsions de la nature ; après avoir extravagué sur la situation de l'ancienne Troye, et avoir fait même une description riante de la source de ce hideux torrent, qui baigne les murs d'Iné ; après l'avoir complaisamment enrichie d'une joli bassin, d'un beau platane, et d'un bois romantique ; après avoir retrouvé dans ce torrent tous les caractères du Scamandre, il finit, par conclure, " que d'après l'autorité de l'histoire, il faut rogner de

" plusieurs milles la nouvelle carte de Troye pour retrouver l'ancienne *."

ON voit par ces derniers mots, que Mr Wood déchiroit les cartes, avec autant de facilité qu'il les faisoit ; mais la Nature ne se laisse pas ainsi mutiler ; et quand on annonce ses révolutions pour appuyer un système, il faut y être autorisé par des faits historiques, bien prouvés, ou par quelques traces subsistantes des désordres passés.

C H A P. XI.

Comparaison du Scamandre et du Simois.

LES sources du Scamandre, sortent de la terre avec une rapidité, qui annonce qu'elles descendent d'un lieu très élevé. Le fleuve qu'elles forment, conserve cette rapidité remarquable, jusqu'à l'endroit où il entre dans son nouveau canal artificiel. Les fréquents tourbillons, que l'on voit se former à sa surface, et qui sont occasionnés par le violent choc de ses eaux contre les nombreuses sinuosités qui leur sont opposées, sont, peut-être, ce qui a engagé le poète à lui donner l'épithète, de *δινήσις* †.

JAMAIS

* Description of the Troude, p. 330.

† Ἀλλ' ὅτι δὲ πόρες ἔχει πολλοὶ πεταμέοι
Εάνθε ΔΙΝΗΕΤΟΣ —————

Ibid. xxi. 1.

————— ἀλλὰ Σκαμανδρός
Οὖτις ΔΙΝΗΕΙΣ ————— Ibid. 124. et alibi passim.

JAMAIS ce fleuve n'augmente ni ne diminue. Les eaux sont claires et limpides comme le cristal *. Les rives sont couvertes des fleurs †. Les mêmes arbres et les mêmes plantes qui croissoient sur ses bords, lorsqu'il combattoit VULCAIN, y croissent encore aujourd'hui ; on y voit *des saules, des lotos, des ormes, et des joncs* ; et l'on y pêche encore *des anguilles* ‡.

MAIS, si le grand HOMERE est d'une exactitude frappante dans les épithetes, et dans les attributs particuliers qu'il donne au Scamandre, il n'est pas moins admirable, dans la comparaison qu'il fait de ce fleuve avec le Simois. Il les caractérise tous deux d'une manière parfaitement analogue à la nature, et à leur état actuel.

LORSQUE le Scamandre, combattant ACHILLE, craint d'être vaincu par ce guerrier, il appelle le Simois à son secours : " Ré-
" unissez-vous à moi," lui dit-il, " mon frere, pour terrasser
" ce vaillant guerrier ; rassemblez toutes vos eaux ; déracinez les
" arbres, et entraînez les rochers !!.

HOMERE ne pouvoit pas peindre avec plus de vérité, la folley du Scamandre, et les ravages du Simois ; mais il n'est pas encore content de son tableau, il veut nous faire connoître la largeur du Scamandre.

b 2

ACHILLE,

* ΕΥΡΡΕΙΟΣ ποταμοῖς—uti jam citat.
εὐρύτο Σάγλαδο ὅδων. Iliad. xxi. 345.

† Εσαν οι λαμπτη Σκαμανδρίφ ΑΝΘΕΜΟΕΝΤΙ
Μυρίου— Ibid. ii. 467.

‡ Καλότο πτελίαι τι, καὶ ἵται, ὃδὲ μυρῖαι,
Καίτο δὲ λατής τοι, ὃδὲ θέρος, ὃδὲ πεπιστος,
Τὰ περὶ καλλὰ γένθρια ἀλις ποταμοῖς πεφύκει
Τείχοττοις ιγχιλίαις τι, καὶ ιχθυις,— Ibid. xxi. 350.

|| Φίλες κατελυγεται, &c. Ibid. xxi. 308.

" ACHILLE, sur le point de succomber lui-même, arrache un
 " orme qui croissoit sur les rives du Scamandre, il le renverse
 " d'un bord à l'autre, et en forme un pont, sur lequel il échappe
 " à la fureur du fleuve *."

C H A P. XII.

Tombeau d'Ægypte.

" **L**A Basse Egypte," dit Mr BRYANT †, " étant un pays
 " plat, et sujet à de fréquentes inondations, ses habitans
 " étoient forcés, d'élever le terrain sur lequel ils bâtissoient leurs
 " édifices. Plusieurs de leurs tours sacrées étoient de hauts
 " monticules de forme conique : On voyoit aussi dans beaucoup
 " d'endroits des éminences, sur lesquelles il n'y avoit point
 " d'édifice, et qui étoient destinées pour les cérémonies de la
 " religion. On les appeloit dans certains lieux, *Taph* : Comme
 " Taph-hanes, Taph-Osiris, et dans d'autres Taphiousa, Taphitis,
 " TAPÉ.

" MAIS comme c'étoit aussi, l'usage, d'enterrer les personnes de distinction, sous des monceaux de terre de la même forme, toutes les éminences consacrées de la religion, furent regardées comme les monumens des héros ; et les Grecs, sur tout, en avoient tous cette opinion. Ils prétendoient mon-
 " trer.

* ————— ὁ δὲ πτέλιον τὰ χρυσά

Εὐφύια, μηγαλών &c.

Ibid. xxi. 242.

† New System of Mythology, vol. i. p. 449.

" trer le tombeau de BACCHUS, à Delphes; celui de JUPITER,
" en Crete."

Mr BRYANT cherche à prouver ici, que les Grecs étoient dans l'erreur, en confondant les monticules sacrés avec les tombeaux des héros; mais HOMERE, et toute l'antiquité, s'accordent à nous convaincre, qu'on n'avoit pas d'autre manière de conserver leurs cendres, qu'en les déposant sous ces éminences. On en trouve de la même forme, et de la même espace dans tous les pays; et partout où on prend la peine de les fouiller, on y trouve toujours quelques débris du corps humain. Il pouvoit y avoir quelques unes d'elles particulièrement consacrées aux cérémonies de la religion; mais on ne peut pas nier, que le plus grand nombre étoit destiné à renfermer les cendres des héros, et de grands personnages.

IL est bien extraordinaire, que les Turcs leur ayent conservé le même nom que leur donnaient les Egyptiens. Cette tradition, que j'ai étudiée avec soin, n'a point été, comme beaucoup d'autres, transmise par les Grecs à leurs conquérans. Les Turcs qui habitent le fond de l'Asie, et les montagnes du Caucale, ceux-là qui n'ont jamais eu de communication avec les Grecs, emploient le même nom pour désigner cette espèce de monumens, et ils ne peuvent l'avoir reçu que des Arabes.

JE ne balance donc point à croire, que le monticule situé près d'Udjek, et qu'ils appellent Udjek-TAPÉ, ne soit un tombeau. Et tout m'engage à penser que c'est celui d'ÆSYTÈS, monument de la plus haute antiquité, puisqu'il subsistoit déjà avant la guerre de Troye.

Ce tombeau, suivant HOMERE, étoit très élevé, c'est du moins l'épithète qu'il lui donne: " POLITÈS, fils de PRIAM, se fiant sur son agilité, alloit de la ville se placer sur le sommet de ce tombeau, pour observer les mouvemens de l'armée Greque *." Il ne pouvoit pas, en effet, choisir une situation plus avantageuse pour distinguer dans son entier l'espace compris entre les deux

caps..

* Iliad. ii. 791..

caps. Il falloit aussi, qu'il eut une grande confiance dans son agilité, car il se trouvoit alors fort éloigné de la ville.

Ce que STRABON écrit relativement à la situation de la vieille et de la nouvelle Ilium, contribue merveilleusement à déterminer la position du tombeau d'ÆSYETÈS. Il prouve, avec le secours de DEMETRIUS, que la vieille Ilium, étoit beaucoup plus éloignée de la mer que la nouvelle : 'Ο τι Πολίτης —

'Ος Τρώων σκοπὼς ἵζε ποδαρεῖης πεποιθὼς
Τύμβῳ τινὶ ἀναρρέτῳ Αἰσουάταιο γεφόρτῳ * ,

μάρταιος ἦν κ. τ. λ. "Et en supposant," dit-il, "que la vieille et la nouvelle Ilium fussent la même ville, POLITÈS auroit fait une folie, si en qualité d'espion Troyen, et se fiant sur son agilité, il avoit été se placer sur le monument d'ÆSYETÈS, (pour observer les mouvemens des Grecs); car en accordant qu'il étoit alors sur un lieu très élevé, il faut convenir que l'acropolis, ou la citadelle de Troye, l'étoit encore davantage; qu'elle étoit, à peu près, à la même distance, et qu'il n'auroit pas eu besoin alors de recourir à son agilité, puisque le monument qu'on montre aujourd'hui comme le tombeau d'ÆSYETÈS est à cinq stades de distance, et près de la route qui conduit à Alexandrie †."

Nous pouvons ajouter, que la même raison qui eut fait accuser POLITÈS de folie, pour aller sur la tombe d'ÆSYETÈS reconnoître l'ennemi, si l'ancienne Troye avoit été située où étoit la nouvelle, le rend très excusable, dans la supposition, où l'ancienne étoit au fond de la plaine; car alors, il lui avoit été impossible d'apercevoir le cap Rhetée du sommet de l'acropolis, où de la citadelle, puisque les collines qui s'avancent dans la plaine, du côté du nord, l'auroient entièrement dérobé à sa vue.

CHAP.

* Iliad. ii. 792.

† STRABO, p. 894.

C H A P. XIII.

Situation du Camp des Grecs.

LES anciens Grecs avoient coutume, et cette coutume s'est encore conservée parmi les modernes, de tirer leurs vaisseaux à sec, sur le rivage, lorsqu'ils devoient faire quelque séjour dans les lieux où ils abordoient. La flotte d'AGAMEMNON, composée de mille vaisseaux, ne pouvant pas trouver place sur une seule ligne, dans l'espace compris entre le cap Sigée et le cap Rhetée, on fut obligé de les disposer sur deux rangs, en forme d'échelle, en sorte que ceux des vaisseaux qui avoient abordé les premiers, étoient plus avancés vers la plaine, et les derniers restoient plus voisins du rivage de la mer. Entre les deux rangs des vaisseaux, on avoit placé les tentes, les statues des dieux, et le siège du conseil*. La tente du Général occupoit le milieu du camp. ACHILLE étoit à l'aile droite, au cap Sigée, et AJAX à la gauche, au cap Rhetée. HOMERE nous donne, lui-même, la disposition de ce camp, dans le quatorzième livre de l'Iliade †.

Mr d'ANVILLE et Mr WOOD ‡, s'accordent tous deux, à placer le cap Rhetée à *la pointe de Berbier*, qui se trouve à plus de six milles du cap de Jeni-chehr, ou du cap Sigée. A coup sûr, si les mille vaisseaux, ou plutôt les mille bateaux, d'AGAMEMNON, avoient eu un aussi grand espace pour se mettre en bataille, ils n'auroient pas eu besoin de doubler les rangs.

Je

* Iliad. xi. 805.

† Ibid. xiv. 30.

‡ Vid. Description of the Troade, p. 317. Mem. de l'Acad. des Inscrif. tom. xxvii. p. 318.

JE pardonne cette erreur à Mr d'ANVILLE, qui n'étoit jamais sorté de PARIS, et qui n'en étoit pas moins l'un des meilleurs géographes de l'Europe ; mais Mr WOOD me paroît d'autant plus criminel, et plus impardonnable encore, que le Dr POCOCKE lui avoit tracé la route du tombeau d'AJAX, et que c'est à cet excellent voyageur que j'en dois la découverte moi-même.

" VERS l'ouest du village de It-guelmes," dit POCOCKE,
 " j'aperçus une pointe de montagne, que je supposai être
 " l'*Aiantéum*, où étoit le tombeau d'AJAX, et sa statue. En de-
 " scendant la plaine de Troye, j'observai un monticule, sur
 " lequel il y avoit encore des débris de marbre, mais je n'ose
 " pas décider si c'est-là le tombeau d'AJAX ou non *." Trop
 modeste POCOCKE ! quel motif a pu vous rendre aussi timide
 dans vos jugemens sur les tombeaux de la Troade ? Avez-vous
 jamais appris que les nations modernes ayent élevés de pareils
 monumens à la mémoire de leurs guerriers ? Ne saviez-vous pas,
 que la forme, et la structure, de ces tombeaux étoient adoptées
 par les plus anciens peuples du monde ? Pourquoi votre excessive
 modestie nous condamne-t-elle à paroître téméraire en avançant
 comme certain, ce que vous n'avez regardé que comme dou-
 teux ?

Du moment que Mr WOOD a trouvé, que la distance entre le cap Jeni-chehr et la pointe des Berbiers, (qu'il a confondu avec le cap Rhetée), étoit de douze millés, il n'est pas étonnant, qu'il ait accusé le poète d'exagération, quand il nous représente AGAMEMNON faisant entendre sa voix jusqu'au vaisseau d'ULYSSE, qui étoit au centre de l'armée †.

Au reste, il est probable, que c'est STRABON lui-même qui a égaré Mr WOOD et Mr d'ANVILLE, en assurant que la distance du Cap Sigée au Cap Rhetée étoit de soixante stades ‡.

J'AI

* Description of the East, &c. vol. ii. part ii. p. 104, 105.

† Description of the Troade, p. 336. Iliad. viii. 220.

‡ STRABO, p. 890. Edit. Amst. 1707.

J'AI fixé géométriquement cette distance, et je l'ai trouvée de trois mille toises, mesure qui se trouve parfaitement d'accord avec celle de trente stades, que PLINE nous a laissée *.

EN considérant les marais qui occupent, maintenant, une partie de l'espace compris entre les deux caps, et qui l'occupaient de même au tems de STRABON ; en reflechissant, d'ailleurs sur les inondations du Simois, on a peine à comprendre que les Grecs aient assis leur camp sur un terrain aussi désavantageux, et particulièrement, qu'ils aient pu s'y maintenir pendant dix ans.

Mais quoique la guerre ait duré pendant ce long intervalle, il ne paroît pas, même d'après HOMERE, que les Grecs soient restés, tout ce tems, campés entre le Sigée et le Rhetée. On convient généralement qu'ils ne déployerent tous leurs efforts contre la ville, que pendant le printemps et l'été de la dernière année ; et qu'ils ne firent jusqu'alors que ravager les pays voisins, à dessein d'affaiblir leurs ennemis, de diminuer et d'intercepter leurs ressources, et d'oter, enfin, tout moyen de défense à cette ville, qu'ils avoient d'abord regardée comme imprenable. Dans le cours de cette guerre, les Grecs, sans doute, devoient transporter leurs vaisseaux d'un lieu à un autre, selon qu'ils le trouvoient plus convenable à leurs opérations, et à leur sûreté ; et il y a même quelques raisons de conclure, de certains passages de l'Illiade, que lorsqu'ils entreprenoient une expédition dans les pays voisins, ils divisoient leurs forces en plusieurs détachemens, qui, sous la conduite de leurs chefs respectifs, retournoient au rendez-vous commun avec le butin qu'ils avoient fait sur l'ennemi.

ENFIN, à la dixième année il est probable, qu'ils camperent avec l'ensemble de leurs forces à l'embouchure du Scamandre, pendant l'été, saison où le Simois étoit continuellement à sec, excepté après des pluies accidentnelles et de courte durée ; et qu'ils resolurent alors, de porter un coup décisif à leur ennemi. Dans cette situation, et sans doute, bientôt après qu'elle fut

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campée,

* Hist. Nat. lib. v. c. 33.

campée, l'armée fut attaquée de la peste ; et ce redoutable fléau qu'HOMERE dans son enthousiasme poétique attribue à la colère d'APOLLON, et aux imprécations du Prêtre CHRYSSES, n'étoit, vraisemblablement, que l'effet, très ordinaire des vapeurs mephitiques, qui s'exhaloient du terrain marécageux où elle se trouvoit.

J'AI déjà remarqué dans le journal de mon voyage, qu'on trouve encore une quantité de joncs et de tamarins dans ces marais. Cette observation nous rappelle, que DIOMEDE après avoir tué le traître DOLON, dans les environs du camp, met ses armes sur un tamarin, et de peur de ne pas reconnoître, au milieu des ténèbres, l'endroit où il les avoit placées, il a soin de le marquer par un amas de roseaux, et de branches de tamarins *.

QUANT au large bassin circulaire, qu'on voit près du cap Rhetée, et que les Turcs appellent *Karanlik-Limani*, le port fermé, parce qu'il est en effet obstrué par une barre de sable, je serois assez tenté de croire que c'est le port des Achéens.

C. H. A. P. XIV.

Tombeau d'Ajax.

HOMERE ne désigne pas avec précision la position du tombeau d'AJAX ; mais il nous apprend, au moins, que ses cendres reposoient dans la plaine de Troye, avec celle des autres guerriers Grecs.

" PLUT-

* Iliad. x. 465. vide etiam xxii. 17.

" PLUT-à-Dieu," dit ULYSSE, dans son voyage aux enfers,
" que je n'eusse pas remporté la victoire sur AJAX ; la terre ne
" couvriroit pas aujourd'hui les restes de ce héros *."

NESTOR racontant à TÉLÉMAQUE l'histoire de la guerre de Troye, lui dit : " C'est là que reposent le vaillant AJAX, ACHILLE, et PATROCLE semblable aux Dieux, et mon fils, le courageux et l'innocent ANTILOQUE †."

AJAX, suivant DICTYS de Crète, indigné de ce que l'on avait adjugé à ULYSSE le Palladium, menaça de sa vengeance, et ses juges, et son rival. Comme ceux-ci redoutoient, sans doute, son courage, ils se tinrent sur leurs gardes pendant la nuit suivante, et comme le jour suivant l'on trouva le guerrier sans vie, chacun d'eux se montra très empressé de connoître la cause de sa mort. NÉOPTOLEME, en attendant, fit apporter du bois pour bruler son corps ; il rassembla ses cendres dans une urne d'or, et il les déposa dans un tombeau, qu'il éleva en son honneur, près du cap Rhétée ‡.

STRABON, comme on l'a déjà dit, s'exprime clairement, à l'égard de la position de ce tombeau, dans sa description générale de la plaine de Troye.

UN certain Myrien apprit à PAUSANIAS, que le tombeau d'AJAX étoit situé près du rivage de la mer ; qu'une inondation en avoit altéré les formes, et découvert l'entrée : Et que l'on pouvoit se faire une idée de l'énorme taille de ce héros, par la grandeur des ossemens qu'on y avoit trouvés ||.

L'OUVERTURE dont parle ici PAUSANIAS, sur le rapport d'un Myrien, se voit encore au cap Rhetée, et les Turcs l'appellent, comme je l'ai déjà dit, In Tapé-gheulu, *la grotte du marais*. Comme le monument est renversé depuis le sommet jusqu'à sa base, on distingue toute sa construction interieure, qui consiste d'abord dans une voute, en forme de croix, qui se trouve vers le milieu de sa hauteur, et dans un noyau de maçon-

* Odyss. xi. 547.

‡ De bello Troj. lib. v. c. 15.

† Ibid. iii. 109.

|| Lib. v. 616.

nerie, autour duquel on a élevé des murailles circulaires à une petite distance les unes des autres, et décrites de differens centres.

L'HISTOIRE garde le silence sur l'époque où le tombeau d'AJAX a été renversé. Faut-il croire avec le Mysien, que les dieux indignés contre ce blasphémateur, dirigerent les flots de l'Hellespont contre sa sépulture ? non. J'aime mieux supposer, que le grand POMPEE, lorsqu'il enleva sa statue, s'empara de ses cendres en même tems, pour les transporter en Egypte.

C H A P. XV.

Vallée de Thymbra.

LE nom très peu alteré de *Tbimbrek*, que les Turcs donnent à cette jolie vallée, qui s'ouvre du côté du nord dans la plaine de Troye, sa situation dans le voisinage du tombeau d'ILUS, et du camp des Grecs, me rappela, sur le champ, le récit du traître DOLON, qui pour éviter la mort, fait connoître à ULYSSE et à DIOMEDE les différens postes, qu'occupoient les Troyens et les auxiliaires. "HECTOR," leur dit-il, "tient conseil sur le tombeau d'ILUS * ; les Cariens, les Pœoniens, les Léleges, les Mysiens, les Phrygiens, et les Mœoniens sont dans la vallée de Thymbra †."

LORSQU'après avoir reconnu cette vallée, et le fleuve qui la traverse, je vins à observer au milieu d'un large marais, le point où ce fleuve se réunit au Simois, il me parut impossible d'expliquer comment les anciens, qui plaçoient ordinairement leurs temples dans les situations les plus avantageuses, ou sur

* Iliad. x. 414.

† Ibid. 428.

de hauts promontoires, ou au milieu de riantes vallées, avoient aussi mal choisi celle du temple d'APOLLON. Ce point d'ailleurs assigné par STRABON, ou plutôt par ses traducteurs, se trouvoit en contradiction avec la distance de cinquante stades, que ce géographe établit lui-même, entre la nouvelle Ilium et le temple d'APOLLON.

JE soupçonnai donc encore, quelque erreur dans STRABON, ou dans ses traducteurs, et je ne tardai pas à m'en convaincre, lorsque je découvris les ruines d'un temple près du village de Halil-Eli, dans la vallée de Thimbrek, et que parmi ces ruines, je trouvai l'inscription d'une offrande faite à APOLLON par les habitans d'Ilium. Pourquoi, en effet, auroit-on donné le surnom de Thymbréen au dieu qu'on adoroit dans ce temple, s'il n'avoit pas été situé dans la vallée de Thymbra ?

ON fait qu'ACHILLE fut tué dans ce temple, en allant épouser POLYXÈNE, accompagné seulement de quelques fidèles compagnons, et s'abandonnant à la foi des traités*. Comment PARIS et les Troyens auroient-ils eu la hardiesse de tendre une pareille embûche au vaillant ACHILLE, et de l'exterminer, s'ils n'avoient pas été à une distance respectueuse du camp des Grecs ?

Au reste, il n'est pas peut-être difficile de trouver dans STRABON, un sens analogue à ces idées ; il suffit de le ponctuer à propos pour le concilier avec la vérité.

" LE Thymbrius," dit-il, " se jette dans le Scamandre." Si l'on suppose ici une suspension, la phrase suivante nous apprend, " que près du Thymbrius se trouve le temple d'APOLLON, à cinquante stades d'Ilium *recens*, ou la nouvelle Ilium." Voilà sans doute ce que STRABON voulu dire, et non pas que le Thymbrius se jette dans le Scamandre " près du temple d'APOLLON, " Thymbréen †."

CHAP.

* DARES Phryg. de Excidio Troj. c. xxiv.

† STRABO, p. 893.

C H A P. XVI.

Tombeau d'Ilus.

EN passant près des ruines du pont, qui se trouve vers l'emplacement de la nouvelle Ilium, j'apperçus, comme je l'ai déjà dit, sur les bords du fleuve, une éminence qui, quoique très affaissée, presentoit une forme et des dimensions à peu près semblables à celle du tombeau voisin d'Udjek.

COMME cette éminence se trouvoit dans la plaine à très peu de distance du rivage de la mer, c'est à dire du camp des Grecs, je me rapelai, en la voyant, l'inquiétude de NESTOR, qui éveille DIOMÈDE, en lui disant que les ennemis sont à deux pas des vaisseaux, sur le *throfmos* de la plaine*.

IL ne me parut donc pas douteux, que cette éminence ne fut le *throfmos*; mais je ne bornai pas là mes conjectures, je me permis de les étendre plus loin, et je crus entrevoir que le *throfmos* et le tombeau d'*Ilus*, étoient le même monument, comme la colline Batieia et le tombeau de la courageux MYRINNE †. En effet, DIOMEDE averti par NESTOR, dont l'experience et la sagesse ont fait un espece de prophète, se met en marche avec ULYSSE, pour aller vérifier la position de l'ennemi. Ces deux guerriers rencontrent DOLON, espion Troyen, qui pour éviter la mort dont ils le menacent, leur apprend qu'en effet les Troyens sont campés dans le voisinage, (comme NESTOR le leur avoit déjà dit), et que HECTOR tient conseil sur le *tombeau d'Ilus*, avec les généraux Troyens ‡.

Si

* Iliad. x. 160. xi. 56. xx. 3

† Ibid. x. 414.

‡ Ibid. ii. 814.

Si la réunion de ces témoignages ne prouvent pas mathématiquement que le throsmos est la même chose que le tombeau d'ILUS, il est au moins évident que ces deux monumens ne doivent pas être éloignés l'un de l'autre.

SUIVONS maintenant PRIAM, lorsqu'il va redemander à ACHILLE le corps de son fils. MERCURE rencontre le vieux roi, à l'entrée de la nuit, au moment où il arrivoit au tombeau d'ILUS * ; et il le blâme de s'exposer ainsi en voyageant de nuit avec ses trésors, dans la plaine de Troye †. Le tombeau d'ILUS étoit, donc, à une distance considérable de la ville, puisque PRIAM qui en étoit parti de bonne heure dans l'après-dinée, comme on peut le voir dans la partie précédente du vingt-quatrième livre, n'y arrive que presque à l'obscurité de la nuit ; la distance du même monument aux retranchemens des Grecs, devoit être beaucoup moindre, puisque MERCURE dit à PRIAM, qu'il en arrive à l'instant, et qu'il y conduit son char dans un clin d'œil ‡.

D'AILLEURS le tombeau d'ILUS ne devoit pas être éloigné des bords du fleuve, puisque PRIAM "après l'avoir passé, détache " le chevaux et les mules pour les faire boire ||."

CHAP.

* Iliad. xxiv. 349.

† Ibid. 365.

‡ Iliad. xxiv. 401. 443.

|| Ibid. xxiv. 350.

C H A P. XVII.

Situation de l'ancienne Troye.

QUAND les tombeaux trouvés sur l'éminence de Bounarbachi, ne prouveroient pas d'une manière incontestable la position de l'ancienne ville de Troye, il y a plusieurs circonstances dans les deux poèmes d'HOMERE, qui seroient inexplicables et impossibles, si on la plaçoit par tout ailleurs.

LE village de Bounarbachi est situé sur le penchant d'une éminence, exposée à tous les vents. HOMERE, en parlant de la ville de Troye, lui donne l'épithète d'*ημύοισσα* *.

CE même village se trouve au fond d'une plaine immense, dont le terrain gras et noirâtre annonce la plus grande fertilité, et dont les productions actuelles nourrissent les nombreux villages qu'on y voit. PARIS répondant aux injures d'HECTOR, lui propose de se mesurer avec MENELAUS dans un combat singulier, et lui dit : " quelque soit le vainqueur, vous autres " Troyens, après la paix, vous habiterez la *fertile plaine de* " Troye †, et les Grecs retourneront à Argos, pays abondant " en bons chevaux."

LE village de Bounarbachi est à quatre lieues de la mer. Le Troyen POLYDAMAS, après avoir combattu long temps près des vaisseaux des Grecs, donne à ses compagnons le conseil de ne pas attendre l'aurore pour retourner à Troye ; " car," leur dit-il, " nous sommes très éloignés des murailles ‡."

TOUT

* Iliad. iii. 305. viii. 499. xii. 113. xiii. 724. xviii. 174. xxiii. 64. 297.

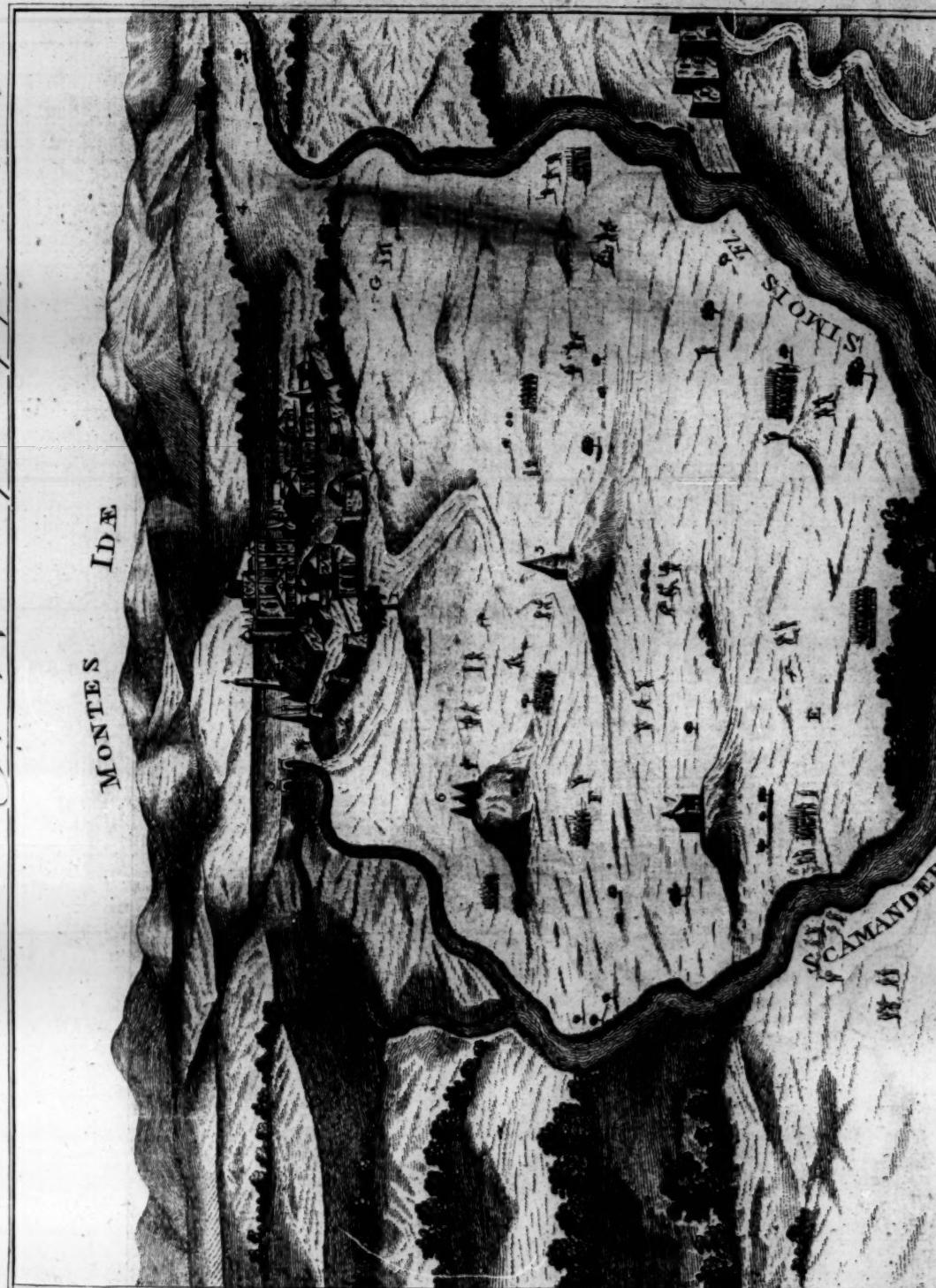
† Ναὶ αὖτε Τροίης ἐγιθάνατο — Iliad. iii. 75. 257. vi. 315. xvi. 461. xxiv. 86. ix. 329. xviii. 67. xxiii. 215.

‡ Iliad. xviii. 256.



*Proprietary of the
Carte de la Plaine de Troy, par Popes. Map of the Plain of Troy.*

MONTES IDE

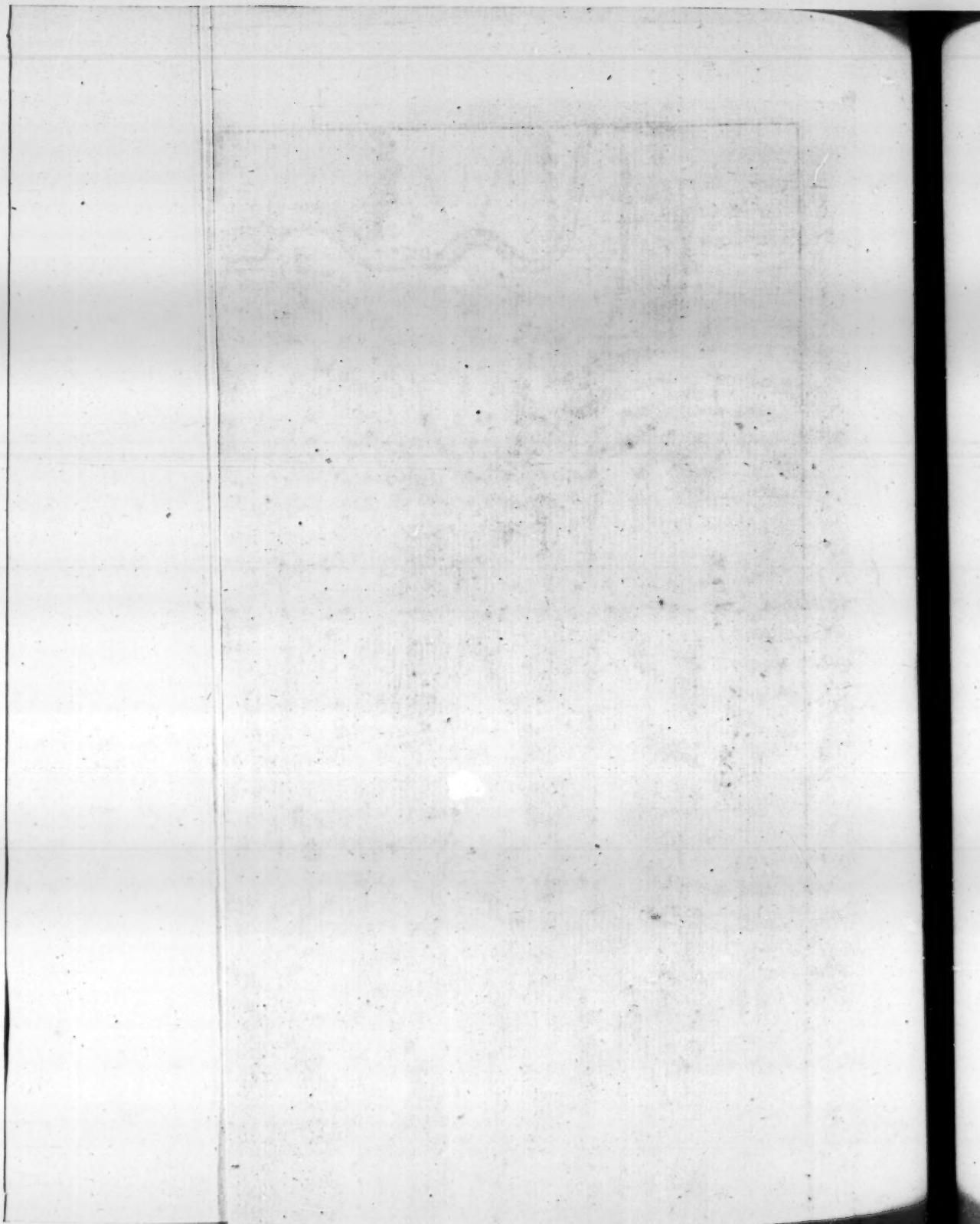




Troy cum locis portugentibus. 1. Porta Scam & Funes. 2. Corpines. 3. Fons. Scamandi abo. 4. Catherdene prope. Simeonis. Batina. sea

Squalorum. Myrines. 6. Hi. Monimatum. 7. Tumulus. E. Syria. A. Moors. Achiorum. B. Leon. Pugne ante naves in ab. 8. 12. 13. 14.

C. Grot. Dimedris. hoc loco ab. s. D. Achillis. & Scamandi. Corinto ab. 22. E. Leon. Pugne in ib. G. Pugne in ab. II. G. Pugne in ab. 20.



TOUT près du village de Bounarbachi, on voit un marais couvert de roseaux très épais et très élevés. ULYSSE raconte à son fidèle EUMÈZE, qu'il avoit passé la nuit en embuscade, près de la ville de Troye, et *au milieu de roseaux* *.

LA ville de Troye étoit inattaquable de tous les côtés, excepté du côté de *la colline des figuiers sauvages*, qui s'étendoit entre les portes Scées, et les sources du Scamandre †. Les précipices qui bordent l'eminence de Bounarbachi, et le Simois qui coule au pied de ces précipices, offroient encore aujourd'hui des difficultés insurmontables à toute armée qui voudroit s'en emparer ; l'on n'en pourroit tenter l'attaque que du côté des sources du Scamandre. Il ne croit plus de figuiers sauvages dans cette espace particulier ; mais cet arbrisseau est très commun dans la plaine de Troye, et j'ai déjà fait observer la singulière analogie du nom que porte le village d'*Erin*, avec celui d'*Erineos* ‡, que portoit la colline voisine de Troye ; c'est près de cette colline, qu'étoient situés les jardins de *PRIAM*, où *Lycaon fut surpris par Achille* ||, *coupant des branches nouvelles*. C'est là que sont encore aujourd'hui ceux de l'Aga de Bounarbachi, qui, après quarante siècles, succéde au roi des Troyens dans sa capitale, dans une partie de ses possessions, et dans son empire absolu sur les habitans de la plaine de Troye, et sur les Agas inférieurs qui les commandent.

LES épithètes d'*ἄκρος, ἄκροπατος*, qu'HOMERE donne partout à la citadelle de Troye, m'autorisoint bien à croire, qu'elle étoit située sur une éminence § ; mais je m'étonnois toujours, que ce grand poète n'eut pas fait mention de ces précipices de Bounarbachi, qui dominent le Simois, et dont l'aspect effrayant et pittoresque, étoit cependant si digne de son pinceau. Ce n'est qu'en suivant ses deux poèmes vers par vers, mot par mot,

VOL. III. *πάσχει την μέρη την πάτερ τον ιωνίαν καὶ την πόλιν την τούτην* que

* Odyss. xiv. 473.

† Iliad. vi. 433.

‡ Iliad. vi. 433. xxii. 145.

|| Ibid. xxi. 35

§ Ibid. v. 460. vi. 88. 257. 317. 512. xx. 52. xxii. 172. iv. 508. vii. 21. xxiv. 700.
Odyss. viii. 494. 504.

que j'ai pu découvrir, que ces hauts rochers qui faisoient la plus sûre défense de la ville de Troye, n'avoient pas été oubliés. DEMODOCUS vantant les exploits, et les ruses d'ULYSSE, raconte comment le cheval de bois fut conduit dans la citadelle : " Aussi-tôt," dit-il, " que les Troyens l'eurent trainé sur le sommet de l'acropolis, ils tinrent conseil, pour délibérer si on lui ouvrirroit les flancs, si on en feroit hommage aux dieux pour les appaiser, ou si on le précipiteroit du haut des rochers *."

LA colline Batieia, où le tombeau de la courageuse MYRINNE étoit en face de la ville †. C'étoit là, que les Troyens, et les auxiliaires, se rangeoient en bataille, tandis que l'armée des Grecs s'étendoit du côté des vaisseaux ‡. Ce tombeau ne subfiste plus, mais il suffit d'examiner la carte ; on voit qu'en disposant l'armée Troyenne entre les rives des deux fleuves, de manière qu'une des ailes soit appuyée sur les bords du Simois, vers *Aktché Keu*, où est Callicoloné, et l'autre vers les bords du Scamandre, un peu au dessous de Bounarbachî, où devoit être le tombeau de MYRINNE, alors elle fait face à l'armée Greque, située entre le cap Sigée et le cap Rhetée.

LES divinités protectrices de ces deux armées, ne pouvoient mieux exciter leur courage, qu'en parcourant alternativement leurs lignes ; c'est ainsi qu'en agissent tous les généraux, au moment où ils conduisent leurs troupes à l'ennemi. Aussi voyons-nous MARS appeler les Troyens, à grands cris, du haut de la citadelle, et volant comme un tourbillon sur les bords du Simois vers Callicoloné ; tandis que PALLAS, animant, de son côté ; l'armée Greque, se trouve, tout à la fois, au cap Sigée, au cap Rhetée, et sur le rivage de la mer ||.

LA route publique paſſoit près des sources du Scamandre, puisqu'HECTOR poursuivi par ACHILLE arrive aux sources, après l'avoir traversée §. On arrive encore aujourd'hui des rivages

* Odyss. viii. 504.

|| Iliad. xx. 48.

† Ibid. ii. 821.

‡ Ibid. xxii. 145.

‡ Iliad. ii. 464.

rivages de l'Héllespont au village de Bounarbachi en passant sur les sources du Scamandre.

Si toutes ces preuves réunies, ne suffisent pas pour fixer irrevoablement la situation de l'ancienne Troye, je me flatte qu'on se laissera dumoins convaincre, par la démonstration mathématique et rigoureuse qui va suivre.

LES portes Scées, (ou les portes du couchant), étoient celles qui faisoient face à la plaine *. C'est par ces portes, que les Troyens sortent, pour aller combattre dans la plaine ; c'est là, qu'HECTOR étoit placé lorsque PRIAM et HECUBE veulent le détourner de se mesurer avec ACHILLE †. C'est enfin du haut de ces portes, que ces infortunés patens, voyent perir leur fils aux sources du Scamandre ‡.

LES sources du Scamandre étoient, donc, en face, et à la vue, des Portes Scées. Elles étoient, donc, au couchant de la ville. Dès qu'une fois l'on m'accorde la position des sources du Scamandre, on ne fauroit me refuser celle de la ville de Troye. La situation de cette ville à l'orient des sources, est incontestable et rigoureusement démontrée.

* EUSTATH. in Iliad. vol. i. p. 394. Edit. Rom. 1550.

† Iliad. xxii. 35.

‡ Ibid. xxii. 405.

C H A P. XVIII.

Tombeau d'Hector.

C'EST une opinion généralement répandue parmi les érudits, que les anciens ne plaçoiient jamais leurs sépultures dans l'intérieur des villes. Les ruines de celles qu'on a découvertes, et les usages actuels des nations orientales, semblent confirmer cette opinion ; mais on fait que quelques peuples, tels que les Lacédémoniens, par exemple, n'imitoient point en cela les autres, et qu'ils entassoloient avec autant d'inhumanité que nous, les morts, et les vivans, dans l'étroite enceinte de leurs murailles.

LES Troyens n'auroient-ils point imité ce barbare usage ? et les tombeaux que l'on voit sur l'éminence de Bounarbachi, et qui dévoient d'après leur situation présente, être enfermés dans la ville, ou aumoins dans la citadelle de Troye, ne sembleroient-ils pas l'indiquer ? non. Les tombeaux d'ÆSYTES, d'ILUS, de la courageuse MYRINNE, étoient hors des murailles, et même à une grande distance de la ville ; pourquoi donc ceux-ci se trouvent-ils dans l'interieur ? La raison en est simple.

LORSQU'UN des chefs des Grecs venoit à perir dans le combat, on le portoit aux vaisseaux, et on lui élevoit un tombeau sous la protection du camp. Les Troyens, au contraire, lorsqu'ils vouloient executer la cérémonie des funérailles de leurs guerriers, n'avoient d'autre défense contre les incursions des Grecs, que les murailles de leur ville. Il ne feroit donc point étonnant, qu'ils ayent été forcés pendant le tems de la guerre,

de

de déroger à leur ancien usage, et d'enterrer les morts dans leur enceinte.

J'ai déjà dit, que des quatre tombeaux qui se trouvent sur l'éminence de Bounarachi, trois sont absolument semblables à ceux qu'on voit sur les rivages de l'Hellespont, et que le quatrième est un énorme amas de pierres, qui semble avoir été bouleversé ; et après m'être assuré mathématiquement de la situation de l'ancienne Troye, ma première idée fut, qu'ils contenoient les cendres des guerriers Troyens ; et ma conjecture à cet égard me paroiffoit d'autant plus raisonnables, que plusieurs auteurs anciens nous apprennent que long temps après la guerre de Troye, on montroit aux voyageurs les tombeaux des Troyens, aussi bien que ceux des Grecs. "Le corps de PARIS," dit DARÈS de Phrygie *, "fut porté dans la ville, et PRIAM lui éleva un "tombeau."

CESAR, parcourant la plaine de Troye, marchoit sans s'en appercevoir sur un monceau de pierres et de gazon, qui n'avoit plus la forme d'un tombeau. "Arretez, CESAR," s'écrie son conducteur, "vous foulez aux pieds les cendres d'HECTOR."

— *Securus in alto*
Gramine ponebat gressus; Phryx incola manes
HECTORIOS calcare vetat †. —

PAUSANIAS, qui nous a déjà fait le récit fabuleux des causes qui avoient renversé le tombeau d'AJAX, nous apprend aussi le motif qui fit ouvrir celui d'HECTOR : "Les habitans de "Thèbes," dit-il, "furent engagés par l'oracle d'aller à Troye, "chercher les cendres d'HECTOR, et de les transporter à "Thèbes †."

VIRGILE

* De Excidio Trojæ, cap. xxxv.

† LUCAN. Phars. ix. 975.

† Grec. Descrip. lib. ix. p. 568. Edit. Hanov. 1613.

VIRGILE nous désigne d'une manière très ingénieuse, la véritable situation du tombeau d'HECTOR.

"ENÉE," dit-il, "abordant sur les rivages de l'Epire, y retrouve la ville de Troye, le Scamandre, la Citadelle, et les portes Scées :

*Procedo, et parvam Trojanam, simulataque magnis
Pergama, et arenem Xanthbi cognomine rivum
Agnosco, Scæaque amplector limina portæ**.

Il rencontre ANDROMAQUE, faisant des libations sur le tombeau de son époux :

*— falsi Simoëntis ad undam,
Libabat cineri ANDROMACHE, manesque vocabat
HECTOREUM ad tumulum †. —*

CETTE infortunée Princesse, cherche dans sa nouvelle patrie, ce qu'elle a perdu dans l'ancienne. Elle donne à un ruisseau desséché le nom du Scamandre dont les eaux limpides ne tarissent jamais, et dont les bords sont toujours fleuris. Elle élève le cenotaphe d'HECTOR, sur les rives du faux Simois, ses souvenirs douloureux alimentent ses larmes, et ils lui sont trop précieux pour qu'on puisse les accuser d'être infideles. On peut s'en rapporter à cette veuve affligée, pour le soin d'imiter le tombeau de son cher HECTOR, et dès qu'ANDROMAQUE pleure sur les bords du faux Simois en Epire, c'est que les cendres de son époux reposent sur les rives du véritable Simois dans la plaine de Troye.

JE les ai vus, Messieurs, ces rivages de l'Epire, où regnoit autrefois HELENUS. La plaine de Butrinto, située en face de l'île de Corfou, a, en effet, des rapports singuliers avec la plaine de Troye ; et le village de Butrinto, comme celui de Bounarbachî,

* Æn. iii. 349.

† Ib. 302.

bachi, est aussi situé sur une éminence, à l'extremité d'une plaine entourée de montagnes, traversée de deux petits torrents, et s'étendant jusqu'à la mer.

LA description qu'HOMERE nous a laissée, lui-même, des funérailles d'HECTOR, s'accorde merveilleusement avec tous les témoignages que je viens de citer ; " On brûle le corps de ce " guerrier, on éteint la flamme avec du vin ; ses parens, et ses " compagnons rassemblent ses cendres en versant des larmes ; " ils les enferment dans une urne d'or, et ils les déposent dans " une fosse, qu'ils couvrent d'une quantité de pierres, et sur " laquelle ils élèvent un tombeau *."

C H A P. XIX.

Des Sources du Scamandre.

J'AI dit dans mon journal, en décrivant les sources trouvées dans la plaine de Troye, qu'elles étoient voisines du village de Bounarachi ; j'ai ajouté, que celle qui est isolée, et qui jaillit du fond du bassin bordé de piliers de marbre et de granit, étoit en hiver chaude, et couverte de fumée ; tandis que les autres nombreux filets d'eau, qui sortent du pied de la colline voisine, et qui se réunissent ensuite, pour former la seconde source du plus petit des fleuves, conservoient en tout tems la même température. Voyons si ces caractères correspondent à la peinture qu'HOMERE nous a laissée des sources du Scamandre.

Ces

* Iliad. xxiv. 797.

Ces sources, suivant lui, n'étoient pas éloignées de la ville, puisque les femmes Troyennes alloient y laver leurs vêtemens, avant l'arrivée des Grecs *. Il paroît aussi, que le phénomène très extraordinaire qui distingue ces sources, n'a pas échappé non plus à ce grand poète. On voit clairement dans le tableau détaillé qu'il en donne, qu'il n'avoit pas été moins frappé de leur singulière différence que de leur abundance, et de leur beauté ; mais l'idée qu'il nous en donne n'est pas tout-à-fait conforme à la nature, ou n'est pas, au moins, exactement rendue : " L'une de ces sources," dit-il, " est tiede, et couverte " de fumée, l'autre, en été, est froide comme la neige ou la " grèle †." La première source, est réellement tiede et couverte de fumée ; mais elle ne l'est pas toujours, comme HOMERE semble l'indiquer, et ne l'est qu'en hyver ; et l'autre est toujours froide.

LES environs des sources du Scamandre, étoient couverts de roseaux très épais, et très élevés, dans lesquels les jeunes filles de Troye, alloient se baigner avant leurs noces, et où la jeune CALLIRHOÉ fut abusée par l'Athenien CIMON, suivant l'aventure qui força ESCHINE de s'échapper précipitamment de la Troade, et qui est racontée dans la dixième des lettres qu'on attribue communement à cet orateur ; aventure véritablement déplorable, puisqu'elle l'empêcha d'observer la plaine de Troye, et qu'elle nous a privé du résultat de ses recherches.

ON peut, quoique il en soit, conclure de cette lettre, que la ville de Troye existoit encore au tems d'ESCHINE ; qu'elle étoit voisine du Scamandre ; que ce fleuve étoit couvert de roseaux, comme aujourd'hui ; qu'ESCHINE s'attendoit à retrouver la plaine, à peu près, dans le même état où HOMERE l'avoit depeinte.

IL n'est pas inutile de remarquer, non plus, que ce même lutteur ATTALUS, cité dans la lettre d'ESCHINE, est le même qui

* Iliad. xxii. 154.

† Ibid. 149.

qui est mentionné dans l'inscription trouvée parmi les ruines du temple d'APOLLON Thymbréen.

Si je ne craignois paroître romanesque dans ma description de la plaine de Troye, j'ajouterois, que j'ai trouvé des femmes Turques du village de Bounarbachi, lavant leur linge aux sources du Scamandre, comme les épouses et les filles des Troyens le faisoient lorsqu'avant l'arrivée des Grecs, elles jouissoient des douceurs de la paix :

————— ὅθι εἴματα σιγαλόεντα
Πλύνεσκον Τρώων ἄλοχοι, καλάι τε θύγατρες,
Το πρὸιν ἐπ' εἰρήνης, πρὸιν ἐλέσειν νίας Ἀχαϊῶν *.

C H A P. XX.

Course d'Hector et d'Achille.

LORSQU'ACHILLE va provoquer HECTOR aux portes Scées †, l'armée Grèque est rangée en bataille dans la plaine, à la vue des murs de Troye. Les Troyens sont réduits aux abois. HECTOR est le seul obstacle qui puisse suspendre un moment leur perte : Les citoyens sont sur les murs, qui font face à la plaine, et aux sources du Scamandre. PRIAM et HEÇUBE sont sur les portes Scées ‡ ; toutes les forces de la ville sont dirigées au point que les ennemis menacent d'attaquer ; chacun tremble pour le sort du vaillant HECTOR, qui est, en ce moment, le seul rempart qu'on puisse opposer aux Grecs victorieux. ACHILLE

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* Iliad. xxii. 154.

‡ Iliad. xxii. 76. 78.

† Ibid. 35. 131.

va à sa rencontre, son aspect l'intimide, il prend la fuite*, (et s'il faut s'en rapporter à l'opinion commune des traducteurs d'HOMERE), il se met à courir *autour* des murs de la grande ville de Troye †. Chaque fois qu'il cherche à gagner les portes, ou à s'approcher des murs, ACHILLE le détourne vers la plaine, et fait signe à ses soldats de ne pas attenter à sa vie ‡.

CES deux guerriers ne courent pas pour une victime ; il s'agit de la vie du grand HECTOR §, c'est à dire, du salut ou de la perte de Troye. Tous ses concitoyens, et sa famille, sont rangés sur les murs, pour attendre de quel côté la balance de JUPITER penchera. La course des deux guerriers est l'époque la plus décisive, et le spectacle le plus intéressant pour les Troyens, et pour les Grecs. Ils ne doivent pas en perdre la moindre circonstance. Chaque pas que fait HECTOR, doit retentir au fond du cœur de PRIAM et d'HECUBE, et les braves Thessaliens doivent exercer à grands cris la vitesse de leur roi.

Si ces deux guerriers s'étoient dérobés aux yeux de leurs armées, et avoient continué leur course autour des murailles, de l'immense ville de PRIAM, les portes Scées seroient-elles restées à la disposition de l'armée Greque ? Cette armée n'étant plus contenue par la présence de son chef, et dans l'incertitude de ce qui se passoit entre les deux guerriers, lorsqu'ils étoient dans la partie opposée de la ville, seroit-elle restée dans l'inaction, et auroit-elle pu modérer son impatience, jusqu'à ce qu'ils eussent fait trois fois le tour des murailles ?

COMPARONS, maintenant, le combat de TURNUS et d'ENÉE, avec celui d'HECTOR et d'ACHILLE. Ceux là combattoient sous les murailles de Laurentum, entre deux armées qui attendoient avec une égale impatience l'arrêt de leur destinées ; voyons comment VIRGILE aura terminé cette importante bataille.

TURNUS ayant résolu d'engager ENÉE dans un combat singulier, et celui-ci étant informé du projet de son adversaire, tous deux se préparent au combat. De bonne heure le matin suivant,

* Iliad. xxii. 136.

† Iliad. xxii. 194. 205.

‡ Ibid. 144. 155.

§ Ibid. 158.

suivant, les Troyens et les Rutules tracent le champ de bataille, sous les murailles de la grande ville*. Les mères inquiètes, la foule du peuple, et les foibles vieillards, se placent sur les tours, sur le toit des maisons, et sur le haut des portes. JUNON du sommet de la montagne voisine, domine sur le champ de bataille, sur les deux armées, et sur la ville de *LATINUS*. Ce roi, accompagné de *TURNUS*; et ENÉE, accompagné de son fils *ASCAGNE*, conviennent des préliminaires du combat, et font un traité qu'ils confirment par les sermens les plus solennels.

EN attendant, JUTURNE, sœur de *TURNUS*, à l'instigation de JUNON, se prépare à faire violer le traité, et à déconcerter les projets du combat. Une bataille générale est la suite de cette ruse. ENÉE y est blessé, et se retire; sa blessure est guérie bientôt après, par le secours de *VENUS*. Mais *TURNUS*, profitant de l'absence de son rival, fait un carnage affreux dans son armée. Le poëte place ici plusieurs incidens. ENÉE retourne au combat, il attaque la ville de Laurentum, et brûle les maisons les plus voisines du rempart. *TURNUS*, enfin, dans un accès de violence et de désespoir, cherche partout son rival. "Il s'avance jusques sous les murailles, où le combat est le plus "acharné, et où les dards sifflent à travers les airs; il fait signe "aux Rutules de la main, et leur crie de ne plus combattre, en "leur declarant, que c'est à lui seul de courir les hazards de cette "journée, quels qu'ils puissent être; et qu'il doit remplir pour "eux toutes les conditions du traité, par la seule force de ses "armes; aussitôt les armées se séparent, et laissent entr'elles un "grand espace†." ENÉE, qui s'en apperçoit, abandonne l'attaque des murailles, et court se mesurer avec *TURNUS*. Le combat s'engage, l'attention des deux armées est entièrement fixée sur leurs chefs: JUPITER pese leurs destinées, comme il avoit autrefois, suivant HOMERE, pesé celles d'*HECTOR* et d'*ACHILLE*. L'épée de *TURNUS*, qui n'étoit pas la fienne, mais qu'il avoit arachée par hazard à son cocher *METISCUS*, se brise en éclats, contre la divine armure d'*ENÉE*. Il n'a plus d'autres ressources

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que

* AEn. xii. 116.

† AEn. xii. 690.

que la fuite ; alors les deux combattans font cinq fois, en courant, le tour du champ de bataille, et autant de fois ils se retrouvent au même point *.

TURNUS s'arrête près d'un olivier consacré au dieu FAUNE, comme HECTOR s'arrête près des sources du Scamandre. Si dans le combat HECTOR lance, en vain, sa pique contre ACHILLE, dont les armes divines résistent à son effort ; s'il crie vainement à DÉIPHOBE de lui en donner un autre ; TURNUS voit, de même, se briser dans ses mains l'épée qui le trahit, et il en demande une autre aux soldats qu'intimidoient les menaces d'ENÉE.

CETTE course circulaire de TURNUS poursuivi par ENÉE, s'exécute non pas autour de la ville de Laurentum, mais sous les murs de cette ville, toujours du même côté, et dans un terrain compris entre cette même ville, un marais, et l'armée des Troyens † ; circonstance que VIRGILE semble avoir supposée pour former à ses combattans une arène, semblable à celle qu'offroit la plaine de Troye, pour les contenir sur le même théâtre, toujours sous les yeux de leurs concitoyens ; enfin pour donner à sa composition une forte d'unité, et pour ne pas blesser la vraisemblance, et le bon goût.

POURQUOI VIRGILE, après avoir suivi son modèle pas à pas, depuis le commencement de l'épisode, paroît-il s'en écarter, relativement à la course particulière de ses deux guerriers ? Au-roit-il risqué de corriger son sublime original dans une circon-stance aussi importante ? L'ouvrage d'HOMERE qu'il avoit, étoit-il différent de celui qui existe aujourd'hui ? Ou le texte même

* *Quinque orbes explent cursu, totidemque retexunt
Huc, illuc* ————— *AEn. xii. 763.*

+ *Et nunc buc, inde buc, incertos implicat orbes;
Undique enim densa Teucri inclusere coronat;
Atque binc vasta palus, binc ardua mania cingunt.* *Ibid. 744.*

même seroit-il susceptible d'admettre l'explication que VIRGILE semble lui avoir donnée ?

EN supposant que le texte n'ait point été alteré, il ne me paraît pas impossible d'y trouver un sens analogue à l'imitation de VIRGILE, et de justifier ainsi son modèle.

L'EXAMEN scrupuleux que j'ai fait de cet épisode m'a convaincu, que la difficulté présente consiste essentiellement, et uniquement, dans la manière d'interpréter la préposition *περὶ*, qui signifie souvent *autour*, mais qui est également employée dans plusieurs auteurs, et dans HOMERE lui-même, pour les mots *juxta*, *propè*, *ad*, qui désignent le voisinage d'un lieu. Si au lieu d'adopter *περὶ* dans le premier sens, on le prend dans le dernier, la difficulté disparaît, les guerriers courrent *devant*, ou *près* de la ville ; il ne subsiste plus aucune différence entre les deux épisodes de l'Iliade et de l'Enéide ; et le grand HOMERE est justifié d'une faute de goût dont la mal-adresse de ses commentateurs l'a, jusqu'à présent, fait accuser.

C H A P. XXI.

Tombeaux d'Achille, de Patrocle, et d'Antiloque.

L'OBSERVATEUR le moins éclairé, le simple matelot lui-même, est frappé de ces éminences coniques, qui sont rangées sur les bords de la mer, et qu'il apperçoit successivement, à mesure qu'il s'avance dans l'Hellespont. Il faut bien que ces monumens ayent un but, et une destination ; on n'éleve pas des masses de cette importance, sans un objet quelconque. Les Turcs qui ont, sans doute, reçu cette tradition des Grecs, prétendent que ce sont des tombeaux d'anciens Sultans, et d'anciens Vizirs, c'est à dire, d'anciens rois, et d'anciens généraux ; car on fait, que les Turcs, comme les autres nations, donnent à tous les souverains, et à tous les chefs, le nom des leurs. Jamais les Sultans ni les Vizirs n'ont été enterrés à la manière des guerriers Grecs. A Brousse, à Magnesie, à Constantinople, dans toutes les villes où ils ont résidé, leurs cendres reposent dans de magnifiques mosquées, qu'ils ont presque toutes élevées de leur vivant.

LE Docteur POCOCKE a mal interprété cette tradition des Turcs. S'il l'avoit adoptée dans son véritable sens, elle auroit, peut-être, levé ses doutes, et il se seroit montré moins timide dans le jugement qu'il a porté sur les monumens de la Troade.

PLINE, STRABON, PAUSANIAS, DION CHRYSOSTOME, et beaucoup d'autres anciens rapportent, comme je l'ai déjà dit, que les tombeaux des guerriers Grecs étoient encore de leur tems en évidence, sur les rivages de l'Hellespont. Ils avoient donc résisté plus de dix siècles aux injures des faisons. Les *speci*

spect des peuples, autant que leur solidité, les avoit garantis de la destruction, pourquoi n'auroient-ils pas subsisté vingt siècles de plus? lorsque, sur-tout, les peuples devenus dans la suite maîtres du pays où ils se trouvent, n'ont pas moins de vénération pour les sépultures que ceux qu'ils en ont chassés.

Il n'y a donc rien d'étonnant, si les deux célèbres Anglois qui m'ont précédé dans la Troade, n'ont pas craint, l'un de soupçonner, l'autre d'affirmer hardiment qu'ils existoient encore; mais quand tous les voyageurs, tant anciens que modernes, ne m'auroient pas guidé dans la recherche des monumens de la Troade, la precision avec laquelle HOMERE décrit leur situation, leur construction et leur forme, l'assurance avec laquelle il prophétise en quelque sorte leur éternelle durée, au-roient suffi pour me les faire decouvrir, et pour m'autoriser à croire à leur existence actuelle. Ecouteons, d'abord ACHILLE faisant executer les funérailles de PATROCLE, " Je lui ai fait," dit-il, " éllever un tombeau d'une grandeur médiocre, mais " j'ordonne aux Grecs qui me survivront, d'en construire un " plus haut, et plus étendu que celui-ci *."

AGAMEMNON racontant à ACHILLE dans les enfers, les cérémonies de ses funérailles : " La déesse, votre mère," lui dit-il, " donna une urne d'or pour enfermer vos cendres, et elle " dit, que c'étoit un présent de BACCHUS, et un chef-d'œuvre. " de VULCAIN. Vos os sont dans cette urne, mêlés avec ceux " de PATROCLE; et dans la même urne on mit séparément, " ceux d'ANTILOQUE, qui, après PATROCLE, étoit celui de " vos compagnons que vous chérissez le plus. Toute l'armée " travailla ensuite à éllever sur ces précieux restes un tombeau, " que l'on plaça sur le haut rivage de l'Hellespont, afin qu'il " soit apperçu de loin par les navigateurs qui passeront dans " cette mer, non seulement dans ce siècle, mais dans les siècles- " à venir. †."

L'IMAGE des tombeaux des grands hommes, a quelque chose de touchant, qui intéresse le cœur à coup sûr. HOMERE, qui

* Iliad. xxii. 245.

† Odyss. xxiv. 73.

qui connoissoit tous les ressorts qui peuvent emouvoir la sensibilité, n'a pas manqué d'employer un moyen dont il attendoit, avec raison, les plus grands effets sur l'âme de ses lecteurs. Voyez combien de fois il rapelle le souvenir de ces lugubres monumens, et avec quel intérêt il les décrit ; il semble qu'il y voit d'avance bruler l'encens des sacrifices, qu'il entend les soupirs, et qu'il voit couler les larmes des voyageurs qui les visiteront un jour.

QUAND HECTOR provoque les guerriers Grecs au combat singulier, il propose au milieu des deux armées les conditions du combat : " Si je fais tomber," dit-il, " mon ennemi sous mes coups, si APOLLON m'accorde la victoire, j'emporterai ses armes dans la citadelle d'Ilium ; je les suspendrai au temple de ce dieu, et je renverrai son corps dans ses vaisseaux, afin que les Grecs lui fassent des funérailles honorables, et qu'ils lui élèvent un tombeau sur le rivage de l'Hellespont, en sorte que dans les siècles à venir, quand les voyageurs passeront dans cette mer ils disent : Voila le tombeau d'un vaillant guerrier, qui dans le temps passé, fut vaincu par le belliqueux HECTOR dans un combat singulier ; ainsi parleront tous les voyageurs, et ma gloire passera d'âge en âge *."

HOMERE nous apprend expressément, que le monument d'ACHILLE et de PATROCLE, étoient de cette espece, et qu'ils étoient situés sur le rivage de la mer, en nous disant : " Que les hommes chargés de transporter du mont Ida les bois nécessaires pour le bucher de PATROCLE, les jettent, par ordre, sur le rivage, à l'endroit qu'ACHILLE avoit désigné pour le tombeau de PATROCLE, et pour le fien †."

IL va nous décrire maintenant leur construction et leur forme : " Les chefs," dit-il, " en parlant du tombeau de PATROCLE, en marquent l'enceinte circulaire, ils en jettent les fondemens, et il les couvrent d'un monceau de terre."

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* Iliad. vii. 81.

† Ibid. xxiii. 123.

JE m'arrête avec enchantement sur ce tableau, dont les détails sont si précieux pour établir l'authenticité des monumens que j'annonce. " On trace l'enceinte du tombeau en forme de " cercle :" En effet, tous les tombeaux de la plaine de Troye sont en forme circulaire. " On en jette ensuite les fondemens :" Il y avoit donc des constructions intérieures ; et HOMERE nous apprend quel étoit leur usage : " On verse de la " terre sur ces constructions *." Cette terre dont il désigne la mobilité par l'épithète *χυτὴ*, se seroit aisément éboulée, et n'aurroit pas resisté long tems aux injures de l'air, si l'on n'avoit pas eu soin de la soutenir par un noyau de maçonnerie.

Il existe encore, ce précieux monceau de terre élevé par la main des Grecs. Ce ne sont plus comme autrefois des ormeaux qui l'entourent ; ce sont aujourd'hui de hauts peupliers, et de lugubres cyprès encore plus tristes et plus amis des sépultures.

Le Docteur CHANDLER regarde avec raison comme celui d'ANTILOQUE, le tombeau voisin d'Jeni-chehr, sur le sommet du promontoire ; mais je ne fais quel motif il a de regarder le suivant comme celui de PÉNÉLEUS.

Quoiqu'il en soit, il est probable d'après la description d'HOMERE, que les deux tombeaux élevés en l'honneur de PATROCLE et d'ANTILOQUE sont de simples cénotaphes, ou qu'ils ne contiennent rien, puisque les cendres de ces deux guerriers furent mêlées avec celles d'ACHILLE, et placés dans son tombeau.

PÉNÉTRÉ de cette idée, dirigé d'ailleurs par la grosseur de celui de ces monumens qui est le plus près de la mer, et par le nom singulier de *Dios-Tapé*, " tombeau du dieu," que lui donnent encore les Grecs du cap Sigée, je le marquai, comme devant, être l'objet de la fouille que je conseillai d'entreprendre.

APRÈS mon départ de Constantinople, malgré la vigilance des Turcs, on est venu à bout, au moyen de quelques présens

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faits

* Iliad. xxiii. 255, 256.

faits aux commandans du fort voisin, d'executer cette perilleuse entreprise. Vers le centre du monument, on a trouvé deux larges pierres, appuyées à l'angle l'une sur l'autre, et formant un espece de tente, sous laquelle, on a trouvé d'abord une petite statue de MINERVE Panthée, montée sur un quadrigé, et une urne de metal, remplie de cendres, de charbons, et d'ossemens humains. Cette urne, qui est maintenant entre les mains du Comte de CHOISEUL, est entourée d'une branche de vigne, à laquelle sont suspendues des grappes de raisin executées avec un art infini.

SONT ce-là les cendres d'ACHILLE ? Je n'en fais rien ; mais ce sont, à coup sûr, celles d'un personnage qui honoroit MINERVE d'un culte particulier, puisquè la statue de cette déesse se trouve avec ses cendres. De plus, il est mort dans un siècle où c'étoit l'usage de bruler les cadavres, puisque voila des cendres, des charbons, et des ossemens encore très reconnoissables ; et quand je vois cette urne de bronze, ornée de pampres, j'avoue qu'il m'est bien difficile de ne pas songer à cette autre urne, présent de BACCHUS et ouvrage de VULCAIN, que THETIS donna aux Grecs, pour y enfermer les cendres de son fils.

MAIS, me dira-t-on, Comment ces cendres se sont-elles conservées si long tems ? Comment ont-elles résisté plus de trois mille ans à l'injure des faisons ? C'est qu'elles n'y étoient pas exposées. La voute sous la quelle elles se trouvoient, étoit couverte d'une couche énorme de sable fin, sur laquelle on en avoit étendu une autre, encore plus épaisse, de terre glaise ; et sur le tout, on avoit élevé une haute montagne. Par ce moyen, l'urne étoit défendue de l'humidité, et du contact de l'air, qui sont les deux grandes causes de la dissolution.

“ CE n'est pas tout,” ajoute le célèbre auteur du *Voyage d'Anacharsis*, le savant et vertueux Abbé BARTHELEMY, “ ces grappes de raisin placées sur l'urne sont executées dans une perfection qui ne convient point au siècle d'HOMERE.”

A CETTE difficulté je pourrois répondre, avec BOULANGER,
" Que le siècle d'HOMERE, quel qu'il soit, a été suivi de
" plusieurs siècles d'ignorance, qui n'ont conservé son livre
" que dans la poussière, et qui en ont fait oublier l'auteur."
Je dirois de cet auteur, quel qu'il soit encore, qu'il n'a pu appartenir qu'à un siècle éclairé, parce qu'il nous présente un génie sublime, orné de connaissances très étendues ; et parce que le language de la Grèce a, dans l'Iliade, une beauté, une finesse, et une perfection, qui n'ont pu être que les suites d'un progrès infini dans le commerce, dans les arts, et dans les lettres.

CEPENDANT pour ne pas choquer gratuitement les érudits, pour ne pas contredire sans raison les annales, les marbres, et la chronologie de la Grèce, nous pouvons comparer, je pense, le degré de civilisation des Grecs au tems d'HOMERE et d'ACHILLE, à celui des Turcs de nos jours. Ceux-là, quoique très ignorans dans les arts, commerçoient avec l'Egypte et l'Asie, comme les Turcs le font avec la France et l'Angleterre. J'ai vu chez plusieurs Pachas, des pendules à Equation, et des sphères, et je ne les ai pas accusés pour cela, d'être astronomes. ACHILLE put acheter un bouclier d'un Egyptien, comme un janissaire achete un fusil d'un Anglois, et ceux qui prirent soin de ses funérailles purent, de la même manière, se procurer une urne élégante pour y déposer les cendres.

QUANT à ceux qui demandent, si j'ai trouvé des inscriptions sur les tombeaux de la Troade, je leurs réponds, qu'il ne paraît pas certain, que les inscriptions en caractères écrits, fussent en usage au tems de la guerre de Troye, puisque HOMERE, n'en fait aucune mention ; mais les vers d'un grand poète, lorsqu'ils peignent la situation et la forme d'un monument, que sa solidité et sa masse imposante mettent à l'abri des injures du tems, sont des inscriptions plus durables qu'une plaque de marbre ou d'airain. HOMERE comptoit autant sur la durée des tombeaux :

qu'il chantoit, que sur l'immortalité de ses tableaux : Τοῖς, ὅι νυν
γεγάσσει, καὶ ὁι μετόπισθεν ἴστοραι *.

Si ces preuves suffisent, Messieurs, pour détruire tous vos doutes sur l'existence de ces précieux restes de l'antiquité, j'acquiers des droits à la même confiance de la part de tous les Savans ; et je me plaît à espérer, que lorsque la Société Royale d'Edimbourg aura prononcé un jugement favorable sur l'authenticité de ces monumens fameux, toutes les Académies de l'Europe s'empresseront de l'adopter, et que les voyageurs éclairés de toutes les nations, que leurs affaires ou leur curiosité, conduiront dans l'Héllespont, se feront un devoir, de dedommager par un culte nouveau, les tombeaux des héros de l'Iliade, de l'oubli criminel dans lequel la barbarie les ait plongés depuis tant de siècles.

* Odys. xxiv. 84.

II.

N. B. The above Paper has been translated into English, and accompanied with large Notes and Illustrations, by Mr DALZEL, Professor of Greek in the University of Edinburgh; with the approbation of the Committee of Publication of this Society: And it has been printed in the same form with these Transactions, and published by T. CADELL, in the Strand, London; and W. CAXTON, Edinburgh. 1791.

II. An ESSAY upon the UTILITY of DEFINING SYNONYMOUS
TERMS in all Languages; with Illustrations by Examples
from the Latin. By JOHN HILL, LL. D. F. R. S. EDIN. and
Professor of Humanity in the University of Edinburgh.

[Read by the Author, Feb. 18. 1788.]

WORDS that are precisely equivalent are rarely, if at all, to be met with in any language. Those properly called *synonymous*, exhibit one leading circumstance in which they all agree, and one or more accessory circumstances in which they differ. When the point of their general coincidence, and the grounds of their particular diversities, are clearly ascertained, it is then in the power of the writer to use them with propriety. By the assistance of the grammarian, he knows which to adopt and which to reject, and can reconcile embellishment with accuracy and precision.

THE excellence of any language may in a great measure be judged of, by the number of synonymous terms that belong to it. A multiplicity of them, under skilful management, creates no hurtful redundancy. On the contrary, it enables every author of taste to exhibit his thoughts with energy and lustre. For the most delicate variety of shades in thought, he is furnished with a corresponding variety in expression; and the language in which he conveys his idea, becomes a complete picture of the idea itself.

THE author of this essay is abundantly sensible, that though the Latin tongue presents many classes of synonymous terms,
yet

yet to catch the circumstance on which their differences rest, is no easy matter, and may often leave room for diversity of opinion. After a careful examination of the classical writers, he suspects it will be found, that in the glow of composition, the strict distinctions between such words have not been always attended to, and that the purest writers have occasionally deviated from the standard which their general practice had established. Still, however, he apprehends, that there is room for a critical and scientific discussion of the Latin synonymous terms. As this is a subject to which, in the line of his profession, he was led to give particular attention, and as he considers it to be of no small importance to those who wish to discriminate the slightest violation of purity in the Roman language, he has made a very large collection of its synonymous words, with remarks upon them. The following specimen of the instances he has collected, he submits, with much diffidence, to this learned Society.

ROGARE, PETERE, POSTULARE, POSCERE, FLAGITARE, agree in denoting the expression of a desire to obtain something not possessed, but differ in respect to the urgency with which this desire is announced. They are all distinguished from the verbs *cupere* and *optare*, which, though not equivalent, suppose, like them, the existence of desire, but not the expression of it, with a view to its being fulfilled.

THE power of the verb *rogare* extends no farther than to the simple intimation of desire. By means of it, a want is suggested to the person addressed, of which he was before ignorant, and both he and his petitioner are supposed conscious, that compliance with the request must be voluntary and the effect of good-will. “ Molestum verbum est, et onerosum, et demissum “ vultu dicendum *rogo**.” —“ Malo emere quam *rogare* †.”

HE

* Sen. Ben. 22.

† Cic. in Ver. 4. 12.

He who proposed a law in the Roman Comitia, and was then said *rogare legem*, presented his request respectfully, and left it to the Assembly to judge as to the expediency of granting it.

PETERE differs from *rogare*, in supposing a certain difficulty in coming at the object desired, and a greater degree of keenness upon the part of the petitioner. "Ad te confugimus, a "te opem petimus*."—"Cum a me peteret et summe conten- "deret, ut propinquum suum defenderem †."—"Id sibi ut do- "naret, *rogare* et vehementer *petere* cœpit ‡." In the last ex- ample, the verbs *rogare* and *petere* are evidently contrasted. The latter denotes a degree of zeal upon the part of the person who asks, which the former does not.

THE definition now given of *petere* does not correspond with that given by SERVIUS. "Petere," says he, "est cum aliquid "humiliter, et cum precibus postulamus §." With all the respect due to so great a critic, it may be urged, that this power of *petere* is not to be discerned in the verb when taken by itself, though it may be expressed by words with which it is occasionally accompanied. Thus, CÆSAR, *De Bello Gallico*, says, "Suppliciterque locuti, flentes pacem petissent."—"Pueri "mulieresque, passis manibus, pacem ab Romanis petierunt ||." Nothing in either of those instances serves to prove, that the keenness of the petitioner, which marks the verb, may not exist, independently of the manner in which the request is presented. The manner is in fact expressed by those terms that happen to be adjuncts to the verb.

PETERE, from the Greek verb *πέμπω*, *ferri*, *volare*, shews its native force in such derivatives as *impetus* and *præpes* **. It seems

* Cic. Tusc. Q. 5. 5. † Cic. Quin. 14. a. ‡ Cic. Ver. 215. a.

§ Æneid. 9. 193. || 1. 27. & 2. 13.

** The observations of the celebrated GESNER upon this verb, are worthy of that extensive erudition and acute discernment for which he is justly distinguished. By means of his accurate remarks upon the force of some single terms, my labour in tracing the circumstance by which they are allied to other ones, has been abridged; and no scholar should be ashamed to avow his obligations to so able a guide.

seems to have originally expressed an effort to come at objects not within reach, and to have been transferred from material objects to intellectual conceptions. Its primitive power appears in such instances as the two following : “ Sciebam CATILINAM “ non latus aut ventrem, sed caput et collum *petere* solere*.” —“ Malo me GALATÆA *petit*, lasciva puella †.”

THE power of *petere*, thus limited, appears to have been afterwards extended, so as to express a desire, accompanied with an effort to obtain any object whatever ; and thus the original idea of bodily exertion was lost in that of the eagerness of any pursuit. Candidates for offices at Rome were said *petere magistratus*; and from a sense of the value, as well as of the difficulty of obtaining the object, they were keen in the pursuit of it.

FROM a passage in HORACE, it should seem, that any means for the acquisition of an object that are less than coercive, may be expressed by the verb *petere*.

— — — CÆSAR, qui cogere posset,
Si peteret per amicitiam patris atque suam, non
Quidquam proficeret †.

Nothing more is suggested here by *petere*, than CÆSAR's keenness to hear this musician perform. It were absurd to suppose, that the Emperor, who possessed the power of compulsion, would ever stoop to beg the favour, according to SERVIUS, “ humiliter et cum precibus.”

POSTULARE differs from *petere*, in as far as it suggests neither keenness nor difficulty in the acquisition of the object. Besides the sentiment of desire, which is common to all the five verbs compared, the idea of claim, which is manifestly not inherent in either of the two former, is essential to *postulare*. Upon a proper limitation of this claim, however, a due apprehension of the power of the verb depends.

THE

* Cic. pro Muræn. 136. b.

† VIRG. Ec. 3. 64.

‡ Hor. S. 1. 3, 4.

THE distinctive character of *postulare* seems to rest on the acknowledged reasonableness of that which is demanded. "Geo-
" metræ solent non omnia docere sed *postulare*, ut quædam fibi
" concedantur, quo facilius quæ velint explicit *." When
geometers require any concession of those they are about to in-
struct, they appeal to their reason, and tacitly bind themselves
to allow the validity of that which they require. The axiom
again, which is an undeniable principle, carrying with itself
its own proof, is not to be confounded with the postulate or
entreated maxim. Other philosophers, as well as mathematicians,
establish postulates, though often in terms less definite,
and of course more readily mistaken. " M. Dasne igitur hoc,
" POMPONI, Deorum immortalium vi, natura, ratione, naturam
" eam regi? A. Do sane si *postulas* †."

CICERO uses the expression, " Impudenter *rogare*, impu-
" dentissime *postulare* † ;" and thus intimates, that the inde-
cency which was culpable in the bare suggestion of a desire, as
implied in the former verb, rose in a superlative degree, when
to this was superadded the idea of a claim, as implied in the
latter.

IT appears from QUINTUS CURTIUS, that the insolence of
DARIUS, after a severe defeat, provoked ALEXANDER. He
not only took to himself the appellation of King, without gi-
ving it to his Conqueror, but presented his requests in terms
that became not his situation. The historian of ALEXANDER
accordingly says, " *Postulabat autem magis quam petebat* §."

POSERCERE agrees with *postulare*, in supposing, that the petitioner
has a claim to have his request granted; but it besides denotes,
that he himself is entitled to judge as to the validity of that
claim, without regard to the opinion of the person requested,
or to the acknowledged equity of the demand. Thus, CICERO

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says,

* Cic. de Off. 58. b.

† Cic. de Off. 1. 88.

‡ Cic. de Legg. 1. 7.

§ QUIN. CUR. 4. 1.

says, “ Nemo tam audax qui *posceret*, nemo tam impudens qui
“ *postularet**.” The pointed opposition made here by the ora-
tor between the two verbs, shews clearly the meaning affixed
by him to each. Impudence, he tells us in the last clause, or
a contempt for the opinion of the world, who would judge as
to the propriety of the demand, is all that would be needful
for enabling the petitioner to present it in the form denoted by
postulare. With regard to *poscere*, however, the case is different.
A sentiment of courage is supposed needful, when a petition,
implying the violation of some private right, was to be present-
ed. A matter of favour would, with an unbecoming boldness,
have been held forth as a matter of right, so that the person
requested might reject the petition, as being an insult to him-
self.

THE definition given by VARRO of *poscere* seems perfectly
just, except only in as far as a compound is preposterously
taken to state the power of the verb itself. “ *Poscere*,” says
he, “ est quoties aliquid pro merito nostro deposcimus†.” Had
the critic taken the trouble previously to define “ *deposcere*,”
we should have been at no loss to understand his account of
the simple verb. His definition appears to be, in other respects,
complete, as he supposes the petitioner possessed of the power
of measuring the extent of what he styles “ *meritum*.”

THE different uses of the verb *poscere* may be all reconciled
with the definition now given, when it is applied to the inter-
course that takes place between man and man. In its applica-
tion, however, to those petitions that were presented by the an-
cients to their gods, its power becomes more mysterious. The
idea of right is not easily reconciled with that of supplication;
so that, according to the definition given of the verb, those
who were said *poscere deos veniam*, might well be accused of
profaneness.

IN

* CIC. in Ver. 4. 44.

† SEAV. ÆN. 9. 193.

IN order to obviate this seeming objection, it must be remembered, that a difference of opinion respecting the same act in any two countries, may very naturally produce a difference in the interpretation of those words, that are expressive of this act in each. Undefined terms have in this way become a fruitful source of controversy in matters both civil and religious; and even the science of grammar has suffered by those inaccuracies of expression, which it professes to remedy in all other subjects. The religious sentiments of the Romans were by no means refined. Vows were presented as bribes to their deities, into whose ear they whispered petitions, which they were ashamed to acknowledge in the face of the world. “*Turpissima vota
“ diis insusurrant; si quis admoverit aurem, conticescent, et
“ quod scire hominem nolunt deo narrant**.” The prayer of such worshippers, then, was a matter of traffic, not an act of devotion. That disinterested benevolence, in reliance upon which more pious supplicants present their requests, was none of the attributes of a Roman deity. The humiliation of the devotee was in his own eyes an article of merit; and he left the altar on which he had laid his offering, feeling the obligation imposed on that being to whom it was presented.

MANY passages in the Latin classics confirm the truth of the observations now made.

— non tu prece *poscis* emaci,
Quæ nisi seductis nequeas committere divis †.

“ Antequam limen Capitolii tangant, aliis donum promittit,
“ si propinquum divitem extulerit, aliis si thesaurum effoderit.
“ Ipse Senatus recti bonique præceptor, mille pondo auri Capitolio
“ promittit. Omnibus diis hominibusque formosior videtur massa
“ auri, quam quicquid APELLES PHIDIASVE, Græculi delirantes

n. 2

“ fecerunt.

* SEN. Ep. 10.

† PERS. SAT. 2. 3.

“ fecerunt *.” — “ Prisco instituto rebus divinis opera datur. “ Cum aliquid commendandum est, prece; cum solvendum, “ gratulatione; cum exposcendum, voto †.” The vow then among the Romans was a bribe, the acceptance of which was deemed obligatory upon the party who took it. As means leading to an end, it necessarily preceded the claim, and was the foundation on which it was built.

THE same notions respecting vows prevailed among the Greeks, as well as the Romans. In the prayer of the priest who had been affronted by AGAMEMNON, the Grecian bard makes him state his claim to be heard in the most express terms.

————— εἰ ποτὲ τοι χαριεῖντ’ επὶ νηὸν ἐγέψεαι,
Η εἰ δὴ ποτὲ τοι κατὰ πιονα μηδί’ εκῆναι
Ταυρῶν ηδ’ αἰχμῶν, τοῦδε μοι καπηνον εελθως †..

FLAGITARE differs from *postulare*, and agrees with *poscere*, in supposing the justness of the privilege assumed by the petitioner, of judging as to his own claim. Its power, however, is more extensive than that of *poscere*, because to the idea of being the judge of the validity of his right, it superadds that of effecting his purpose by such means as he reckons fit for doing so. In those means, at the same time, there may be a considerable variety. The petitioner may either distress the person requested with incessant importunity, or he may threaten vengeance, if the claim which he feels himself entitled to enforce is not fulfilled. That *flagitare* has more power than *rogare* and *postulare*, appears from the two following sentences: “ Metuo “ ne té forte flagitent, ego autem mandavi ut rogarent.” — “ Ta- “ metsi causa postulat, tamen quia postulat, non flagitat, ego præ- “ teribo §.”

IN.

* Petron. Arbit. 88. 8.

† IAIAD. a. 39.

† Val. Max. 1. 1. 1.

§ Cic. Ep. Fam. 98. et pro Quint. 13.

IN the oration of CICERO for PLANCUS, he calls upon LATERENSIS to specify his charge, and to mention any one tribe that his friend had corrupted in his competition for the AEdileship. "Etiam atque etiam insto atque urgeo, infector, posco
"atque adeo flagito crimen *." There is evidently a climax in the five verbs that compose this sentence, and the gradation is very happily supported. By means of *poscere*, the orator makes a requisition in behalf of his client, of the justice of which he had a right to judge, and by the public manner in which this requisition was made, he virtually threatens him with the penalties of law, if it was not complied with; which last conception is involved in the verb *flagitare*.

AUSONIUS POPMA defines this verb very properly, "Vehe-
"menter et plerumque cum strepitu et convicio poscere †."

THE gentlest power of *flagitare*, which is that in which the petitioner proposes to effect his purpose only by teasing, appears in such examples as the two following: "Implorare et
"flagitare auxilium Consulis ‡."

— nec potentem amicum:
Largiora flagito,
Satis contentus unicis Sabinis §.

THERE are other instances again, in which *flagitare* implies, that the petitioner threatens the person requested, and excites fear, in order to effect his purpose.

Ejicite ex animo curam atque alienum æs,
Ne quis formidet flagitatem suum ||.

" PETREIUS.

* Cic. pro Plan. 48.

† Hor. Car. 2. 18. 12.

‡ De diff. Verb. lib. 2.

|| Plaut. Prol. Cas. 23.

§ Cic. pro Rab. 9.

" PETREIUS atque AFRANIUS quum stipendum ab legionibus
 " pœne seditione facta flagitarentur, cuius illi diem nondum
 " venisse dicerent, CÆSAR ut cognosceret postulatum eft *." The
 request made by the soldiers, in order to obtain their pay be-
 fore it was due, was very different from that made to CÆSAR
 in order to have the matter settled.

THERE is a passage in TACITUS, in which the three last of the five verbs considered are so placed, that the meaning of each is very elegantly and decisively brought forth. The historian is describing the sentiments both of OTHO and of the army at Bedriacum, which he had left just before the engagement that was to decide the contest between him and VITELLIUS. " Ibi
 " de prælio dubitatum; OTHONE per literas flagitante ut ma-
 " turarent; militibus ut imperator pugnæ adesset poscentibus;
 " plerique copias trans Padum agentes acciri postulabant †." By forming this anticlimax, TACITUS gives information to the grammarian which is worthy of his attention. The terms of the Emperor's message, in which *flagitare* is used, are expressive of his authority, and intimate the danger of not complying with his request. Those which announce the sentiments of the soldiers, by means of *poscere*, are expressive of no unbecoming menace towards their commander, but make the fulfilment of their right to be led on to battle by him, the condition of their obedience. Many, again, whose request is announced by *postulare*, suggest a reasonable claim, in which there is not even the shadow of contumacy. They are willing to obey the orders of their commander with all prudent dispatch, and even in his absence, and they require a reinforcement, not as a right, but as the means of doing justice to their own courage, and to the cause which they had espoused. The delicacy exhibited by the historian in this description, will please the more the longer it is contemplated. He not only delights his

* Cœl. Bell. Civ. 1. 87.

† Tac. Hist. 2. 39.

his reader by an elegant and masterly discrimination of the various sentiments then prevalent in the minds of OTHO and his followers, but furnishes him also with some curious grammatical facts, which few other writers had ingenuity to perceive.

DOCERE, ERUDIRE, INSTITUERE, IMBUERE, agree in denoting a change produced upon the mind by communication from others, but differ in respect, either to the state of that mind to which the communication is made, or to the means employed in making it. *Docere*, which, according to VARRO, comes from *do*, signifies to give information to those who need it, without reference to their previous knowledge, and is a correlative term in respect to *discere*. Thus, SENECA says, “*Homines dum docent, discunt* *.”—“*Itaque non facile est inventire qui quod sciat ipse, alteri non tradat. Ita non solum ad discendum propensi sumus, verum etiam ad docendum* †.” That *docere* is applicable to all who receive instruction, whether ignorant, or in a certain degree previously instructed, appears from the following passages: “*Quid nunc te Afine literas doceam?* Non opus est verbis sed fustibus ‡.”

Hoc quoque te manet, ut pueros elementa *docentem*,
Occupet extremis in vicis balba senectus §..

In the passages now quoted, *docere* supposes the minds receiving the information to be completely ignorant; but in the three that follow, they appear to be in a state directly contrary. “*Et docebo fus (ut aiunt) oratorem eum, quem quum CATULUS nuper audisset, fœnum alias aiebat esse oportere* ||.”

Plura recognoscet, pauca *docendus* eris **.

“ Quid.

* Epist. 7.

§ Hor. Ep. 1. 20. 17.

† Cic. de Fin. 104. a.

|| Cic. de Or. 2. 233.

‡ Cic. in Pis. 95. a.

** OVID. Faſt. 4. 418.

" Quid est enim aut tam arrogans, quam, de religione, de rebus
" divinis, ceremoniis sacrīs, pontificum collegium docere co-
" nari *."

DOCERE is almost the only one of the verbs mentioned, that is employed to denote information given as to an event, as well as the acquisition of a new conception. " Cum interea ne li-
" teras quidem ullas accepi, quæ me docerent quid ageres †."

ERUDIRE, from *e* and *rudis*, differs from *docere*, in referring always to the rude state of the person instructed, and to the gradual progress by which he becomes learned. No such expression as " *sus erudio oratorem*," can exist, because, when *docere* is thus used, it vilifies the ability of the teacher, and heightens the information of the scholar. When the Romans used the phrase *sus Minervam*, the construction was to be completed by *docere*, not by *erudire*. They only admitted in idea the possibility of adding one or a few facts to the stock of knowledge, possessed by the goddess of learning.

THE instances that follow shew clearly, that *erudire* constantly implies the absence of information upon the part of the person to be instructed.

— qui mollibus annis
In patrias artes erudiendus erat ‡.

" Inde puerum liberū loco cœptum haberi, *erudirique* artibus
" quibus ingenia ad magnæ fortunæ cultum excitantur §."—
" Philosophia omnium mater artium nihil aliud est quam do-
" num inventum deorum. Hæc nos primum ad illorum cul-
" tum, deinde ad jus hominum, quod situm est in generis hu-
" mani societate, tum ad modestiam magnitudinemque animi
" *eruditivit* ||." In this last example, the progress of man, as
the

* Cic. pro Dom. 219. b.

§ Liv. I. 39.

† Ep. 34. a.

|| Cic. Tuſc. Q. 161. b.

‡ OVID. Ep. I. 112.

the pupil of philosophy, is beautifully painted by *erudire* in its purest sense.

THERE is no inconsistency in *docere* and *erudire* appearing in one sentence, and being applied to the different degrees of proficiency made by those acquiring knowledge. "Neque solum
"vivi atque præsentes studiosos discendi erudiunt atque docent,
"sed hoc idem etiam post mortem monumentis literarum asse-
"quuntur *." SALLUST says of SYLLA, that he was "literis
"Græcis, atque Latinis juxta, atque doctissime eruditus †." Upon the principles laid down, this compounded expression will bear to be analysed. The participle, it should seem, denotes, that he had been regularly instructed in Greek and Roman literature, and the adverb, that the stock of his knowledge was such, that few, if any, were able to add to it.

ONE instance occurs in CICERO, in which *erudire* signifies to inform as to an event which *docere* does often. "Obviæ mihi
"velim fint literæ tuæ, quæ me erudiant de omni republica, ne
"hospes plane veniam ‡." This uncommon use of *erudire* seems to justify the definition given of it. CICERO modestly confesses that ignorance of the affairs of the state, in consequence of his absence, which is perfectly consistent with the pure use of *erudire*, and which, when duly represented, his correspondent was able to remove.

INSTITUERE differs from the preceding verbs in denoting the first step of a progress in teaching, and the communication of the elements of whatever is the ground of instruction. The simple verb *statuere*, in a figurative sense, denotes the determination to act, while the compound denotes the commencement of the action that had been resolved upon. It is only, however, as applied to teaching, that this verb can be held synonymous with the rest of the set. "SOCRATES jam senex institui
"lyra non erubescet §." The verb here evidently refers to

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the

* Cic. de Off. 31. b.

† Cic. Ep. 24. b.

‡ Jug. 95.

§ Quinctil. 1. 27.

the first lesson in an art, of which the philosopher was before utterly ignorant. “ Susceperas enim liberos non solum tibi, “ sed etiam patriæ. Eos *instituere*, atque *erudire* ad majorum “ instituta atque civitatis disciplinam, non ad tuas turpitudines “ debuisti *.” *Instituere* here refers to the first step in a process, which *erudire* supposes to be carried on in the education of children. The arrangement of the verbs, however, may be reversed, and each respectively applied to that particular state of certain pupils with which it best accords. “ Senectus adō “ lescentes *docet*, *instituit*, ad omne officii munus *instruit* †.”

IMBUERE differs from *instituere*, in denoting the instilment of sentiments that fit the pupil for making progress in a particular line. It implies intention upon the part of the agent, like the former verbs, and supposes the means of instruction to operate without the consciousness of him who receives it. In its original application to material objects, it had denoted an affection of them in respect to colour, taste, or smell, communicated by means of a fluid, and has been afterwards applied to the production of a mental disposition or aptitude not easily to be destroyed. “ APPiUM CLAUDiUM p̄fectum urbis relinquunt, “ jam inde ab incunabulis *imbutum* odio tribunorum plebis “ que ‡.”—“ Ad hanc legem non *docti* sed *facti*, non *instituti* “ sed *imbuti* sumus §.” *Facti* here suggests the purpose of the Creator in opposition to that of a teacher, at whatever time he might communicate his instructions, and *imbuti* the instilment of preparatory sentiments, before any lesson was given, as involved in the verb *instituere*.

IMBUERE does not always imply the complete absence of information on any subject, but it uniformly implies an effect produced as the means tending to future improvement. “ Sin “ sit is qui et doctrina mihi liberaliter *institutus*, et aliquo “ jam

* Cic. in Ver. 184. a.

† Cic. de Sen. 82. b.

‡ Liv. 4. 36.

§ Cic. pro Mil. 103. a.

"jam *imbutus usu* *." *Institutus* here denotes, that a good foundation had been laid upon which the scholar's progress rests; and *imbutus*, that by habit he had acquired such predispositions, as fit him to advance in that line of study which the orator chalks out.

WHEN HORACE states the good qualities of a slave exposed to sale, he says he was

'Literulis Græcis *imbutus*, idoneus arti
Cuilibet : argillâ quidvis imitaberis uda †.

Though the power of the diminutive in the noun falls properly on the participle, yet no ambiguity is thereby produced in respect to the meaning of *imbutus*. From the words that follow, it evidently implies, that the smattering of Greek literature acquired by the slave, fitted him for making further proficiency.

ERRARE, VAGARI, PALARI, agree in denoting the uncertainty of those who have moved as to the point at which their motion is to terminate, but differ in respect, either to the ground of the uncertainty, or to the number of those involved in it. *Errare* properly signifies to wander, or to deviate from the path leading to a certain point which it is proposed to reach. It supposes, that both before and during the act of moving, an intention existed of coming to a certain place, but that this intention is frustrated from ignorance of the road that leads to it. "Quæ tot vestigiis impressa, ut in his errari
" non possit ‡."

Passibus ambiguis fortuna volubilis *errat*,
Et manet in nullo certa tenaxque loco §.

— procul avius *erras* **.

o 2

" Maxime

* Cic. de Or. 123. 6.

§ Ov. Met. 3. 175.

† Hor. Ep. 2. 2. 7.

** Lucret. 2. 739.

‡ Cic. Ep. Fam. 5. 20.

" Maxime vero mirabiles sunt motus earum quinque stellarum,
 " quæ falso vocantur *errantes* *." It is in this last example
 said, that there is both design, and the power of fulfilling de-
 sign, in the author of that seemingly irregular motion observed
 by the planets. *Errare* is applied to animals grazing. They
 direct their motion not in a straight line, and may often miss
 the best of the pasture they are in quest of.

Mille meæ Siculis *errant* in montibus agnæ †.

— armento teneras *errante* per herbas ‡.

VAGARI differs from *errare* in implying, that the wanderer
 means only to quit the spot he occupies, and has no intention
 to direct his course to any particular place. The person *errans*
 commits a mistake, which the person *vagans* never can, because
 he has formed no plan that can be frustrated. " Non fumus
 " ii quorum *vagetur* animus errore, nec habeat unquam quid
 " sequatur §."—" Curandum est ne *vagum* villicum, nec aver-
 " sum contubernio suo habeamus **."—" Nam fuit quoddam
 " tempus quum in agris homines passim bestiarum more *vaga-*
 " *bantur* ††." Men, at the period referred to, were vagabonds,
 who, knowing no place more desirable than another, continually
 changed their abode.

THE following figurative acceptation of *errans* and *vagus*
 seems to confirm what has been said of the verbs with which
 they are respectively connected. " Est enim et philosophi, et pon-
 " tificis, et COTTÆ, de diis immortalibus habere non *errantem*
 " et *vagam*, ut academicci, sed ut nostri, stabilem certamque sen-
 " tentiam ‡‡." In the antithesis, *errans* is opposed to *stabilis*,
 and

* Cic. Nat. D. 36. a.

** Colum. 12. 1.

† Virg. Ec. 2. 21.

†† Civ. de Inv. 1. 2.

‡ Ov. Met. 15. 14.

‡‡ Cic. Nat. D. 26. a.

§ Cic. Off. 34. a.

and suggests, that the philosopher occupies a point at which he is disposed to rest, without making any attempt to go to another, in which he might fail. *Vagus* again is opposed to *certus*, and implies, that he is free from that want of determination as to the point he is to arrive at, which is peculiar to vagabonds.

PALARI agrees with *vagari*, in implying the act of roving without any settled direction; but differs both from it and *errare*, in suggesting the dispersion of a multitude and the straggling of scattered parties. The two former verbs apply either to one or a number, and have no reference to any party with which they were previously connected. It is otherwise with *palari*; which supposes more than one separated from a company that has been broken.

*Fœmina palantes agit, atque hæc agmina vertit **?

"Teucrorum auxilia, foeda fugâ dispersa, totis campis *palantur* †."

THE purity of the following expression in *LUCRETIUS*, in which *errare* and *palari* are found in the same sentence, may be questioned :

*Despicere unde alios queas passimque videre
Errare, atque viam palantes quærere vitæ ‡.*

The same wanderers cannot be both with and without an object at the same time. While *palari* then marks only their number and their dispersion, the terms " *viam quærere vitæ*" annexed to it shew, that it is not to be understood in its full extent.

MAGNUS:

* Virg. *AEn.* 11. 736.

† Lucret. 2. 9.

‡ Tacit. *Hist.* 4. 18..

MAGNUS, INGENS, AMPLUS, PROCRUS, agree in denoting the magnitude of objects, but differ in respect either to its degree, or to the manner in which it is estimated. The notion of absolute magnitude, it must be observed, is inconceivable. Men have compared the object they denominate *great* with others of the same kind with itself, and have given it its appellation from observing its relative greatness. Thus, "magna balæna" signifies either a whale that is larger than other animals of its own species, or that, compared with other sorts of fishes, exceeds them in size. As *magnus* relates to every kind of greatness, and embraces every object within that predicament, so it may be regarded as the general term. "Magna dii curant, parva negligunt *."

In the original application of *magnus* to material objects, it signifies their greatness in respect both to quantity and number.

Heu *magnum* alterius frustra spectabis acervum †!

"*Magnum* numerum frumenti pollicentur ‡." The mass which in both the above examples is denominated *magnus*, receives this appellation, both from the size of the whole, and from the number of its parts considered separately.

MAGNUS is figuratively applied to immaterial objects, and denotes a superiority in some respect among them, analogous to that of the largest over the smallest material subjects of a species. "Si ut sapientibus placet, non cum corpore extinguntur *magnæ* animæ §."

Magnum pauperies opprobrium jubet **.

INGENS differs from *magnus* in denoting a greatness that is preternatural, and is unexampled in the class of objects to which that

* Cic. N. D. 51. b.

§ Tac. Ag. 46.

† Virg. Geor. 1. 150.

** Hor. Car. 3. 24. 42.

‡ Cic. Ep. ad Att. 82. a.

that specified belongs. It surpasses the power of *maximus*, the superlative from *magnus*, as the latter marks the greatest only among the objects of a species, in respect to a quality, which, though existing in different degrees in each, admits comparison in all. The superiority of that denominated *ingens*, again, is so decided, as to eclipse the rest that participate in its nature.

Scilicet et fluvius qui non est *maximus*, ei est,
 Qui non ante aliquem *majorem* vidit : —
 — et omnia de genere omni,
Maxima quæ vidit quisque hæc *ingentia* fingit *.

HE. Quid jubeam? ER. Ignem *ingentem* fieri.
 HE. Ignem *ingentem*? ER. Ita dico *magnus*
 Ut sit †.

INGENS agrees with *magnus* in admitting an application to objects, of which quantity is not an attribute.

THRAS. *Magnas* vero agere *gratias* THAIS mihi?
 GNATH. *Ingentes* ‡.

CICERO comments upon this passage in a way that puts the precise difference between the terms in the clearest light possible. " Satis erat respondere *magnas* : *ingentes* inquit. Semper " auget assentatio id, quod is, cuius ad voluntatem dicitur, vult " esse magnum §."

DURING the Augustan age, the prose-writers never used degrees of comparison from *ingens*. When VIRGIL styles ÆNEAS " *fama ingens, ingentior armis*," his doing do must be considered as a poetical licence, such as that of MILTON speaking of the leviathan.

Hugeſt of living creatures, in the deep
 Stretch'd like a promontory, sleeps or swims,
 And seems a moving land.

THE

* Lucret. 6. 674.

‡ Ter. Eun. 3. 1. 1.

† Plaut. Capt. 4. 2. 64.

§ Cie. in Læl. 26..

THE superlative *ingentissimus* is not found but in such writers as SYMMACHUS and VEGETIUS, who lived late, and whose practice should not be regarded as a standard. The absurdity, at the same time, is equal, in giving *ingens* either a comparative or a superlative degree; as the essence of hugeness depends on there being nothing in nature in which the quality that it is made to denote, is to be found in a superior degree.

AMPLUS differs from *magnus* and *ingens*, in being limited to that kind of greatness among material objects which consists in superficial capacity. It properly denotes such an extension of a surface as fits it for receiving what it is designed to contain.
 " In qua *amplissima* curia, *amplissimum* gymnasium et complures
 " ædes sacræ: coliturque ea pars et habitatetur frequentissi-
 " me *."

Illos porticibus rex accipiebat in *amplis* †.

" Ad eam multitudinem urbs quoque *amplificanda* visa est ‡." In this last example, the compounded verb marks the power of the adjective very distinctly. It denotes the necessary extension of the precincts of the city, so as to afford commodious habitations for the growing multitude. " Loci præter modum
 " *ampli* vagas imagines reddunt, et nimis angusti sæpe non vi-
 " dentur posse capere imaginum collocationem §."

AMPLUS, like the two words defined, is often transferred from material to immaterial objects. " Suosque omnes per se
 " esse *ampliores* volebat **."

PROCERUS differs from all the words stated, in never being transferred from material to immaterial objects, and in implying,

* Cic. in Ver. 228. a.

§ Auct. ad Her. 22. a.

† Virg. Æn. 3. 353.

** Cic. Am. 109. a.

‡ Liv. 1. 44.

ing, that the magnitude is estimated, not from the extension of the object in all the directions that can take place on a surface, but in that of a straight line, that is either perpendicular or horizontal, according to the nature of the object specified. Applied to the human form and to trees, it denotes tallness; and to fishes and four-footed animals in their natural position, length. The general proportions in each, at the same time, are understood to subsist, according to the law observed in the rest of their kind. “Gallorum quisque *procerissimus* ad pompam “triumphi lectus *.”—“Sues *procero* corpore, capitibus ut sint “parvis †.”

Proceras manibus vertere fraxinos ‡.

———— quo pertinet ergo
Proceros odiſſe lupos? quia scilicet illis
Majorem natura medium dedit, his breve pondus §.

HUMIDUS, UVIDUS, MADIDUS, agree in denoting the quality of wetness, but differ as to the manner in which it is generated and retained. *Humidus* implies, that the object which it specifies not only contains moisture, but is fitted to supply the waste of it, whether by evaporation or otherwise. It comes from *humor*, and that from *humus*, and regards the ground as furnishing a constant supply to those springs which break forth at different parts of its surface. “*Præmisso Cecina ut occulta* “*faltuum pontesque et aggeres, bumido paludum, et fallacibus* “*campis imponeret **.*” *Humidus* then, in its primitive sense, refers to a subject as formed by the hand of nature, and possessed of a quality which, when absent, cannot be imparted, and when present, cannot be destroyed.

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THE

* Sueton. Calig. 47.

§ Hor. Sat. 2. 2. 35.

† Var. de Re. R. 2. 1.

** Tac. Ann. 1. 61.

‡ Hor. Car. 2. 25. 16.

THE definition given by SERVIUS of *humidus*, seems to have been very properly rejected by AUSONIUS POPMA, whose remarks "de differentiis verborum," are often both ingenious and solid. "Humidum," says SERVIUS, "quod extrinsecus habet aliquid humoris * ;" to which POPMA refuses to assent, "Cui non adsentior. Humidum enim proprie est quod in proprio continet humiditatem, ut terra †."

HUMIDUS is transferred from the subject to which, from its etymology, it appears to have been originally applied, to others that strongly resemble it. Thus, VIRGIL speaks of the "humida nox," and means by it that dampness which prevails in the air, next the surface of the earth, from the constant falling of the dew in the course of the night. It is transferred by OVID to the clouds, and by VITRUVIUS to those winds which ordinarily produce rain.

— cadit Eurus et *humida* surgunt
Nubila ‡.

"Auster et reliqui (venti) qui a solis cursu sunt *humidissimi* §."

IN both those applications of the word, there is a reference to a supply of the waste, and of course to the long continuance of the fall expected.

HUMIDUS is occasionally applied to bodies impregnated with moisture, which they receive from others that generated it. CICERO speaks thus of a bed bedewed with tears, "Qui jacet in lecto *humido*,

Ejulatu, questu, gemitu, fremitibus,
Resonando, multum flebiles voces refert **.

The

* In Virg. Ec. 10. 20.

§ Vitruv. 8. 21.

† Lib. 2. 133.

** Cic. Tusc. 9. 2. 33.

‡ Virg. Æn. 3. 198.

The wood of a tree, too, when vegetating, may be styled *bumidus*, on account of the communicated moisture which supports it. Nay, CICERO, in one instance, applies the term to wood that is green and newly cut. “ Ignem ex lignis viridi-“ bus atque *bumidis* in loco angusto fieri juslit *.”

Uvidus agrees with *bumidus*, in supposing, that the substance to which it is applied contains moisture, but does not suggest the means of supplying the waste, from whatever cause it arises. The definition given by SERVIUS of this term is more accurate and satisfactory than that given of *bumidus*. It were better, at the same time, not to derive *uva* from *uvidus*, but to consider the shortest of the two words as the root. “ *Uvidum est,*” says he, “ quod intrinsecus habet aliquod humoris, unde *uvæ* di-“ cuntur †.”

Arboribus redeunt detonæ frigore frondes,
Uvidaque in gravido palmite gemma tumet †.

THE hand of art, it may be observed, can operate in the destruction of the quality denoted by *uvidus*. A grape may lose its juice by its being expressed, or by a forced evaporation superinduced by heat, so as to avoid putrefaction in the substance containing it. When the succulent quality is destroyed completely, the substance left behind quits both the natural tenacity of its parts, and the flavour which distinguished the fruit, and gets into the state denoted by *aridus*. When this quality is removed by an intended evaporation, it is removed only in part. Such a quantity of the juice is retained as is consistent with the preservation of the fruit, and as will emit its flavour. The substance is then in the state denoted by the

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adjective

* Cic. in Ver. 2. 45.

† Ovid. Fast. 4. 235.

‡ In Virg. Ec. 10. 20.

adjective *siccus*, which implies no tendency towards decay. “Ne
“ sicut fragilia et *arida* potius quam *sicca* folia *.”

THE abstract noun *siccitas* is occasionally taken to denote the firmness of the flesh, and of course the strength of an animal. It implies a quality opposite to what is meant by *flaccid*, or being without due tension, and supposes this quality to arise from the natural juices neither being in a superabundant nor a deficient state. Thus, CICERO, talking of the wonderful strength of MASINISSA when at the age of ninety years, says of him, “ Nullo imbre, nullo frigore adduci, ut capite operto sit: sum-
“ mam in eo esse corporis *siccitatem* †.”

SOME very subtle observations of ARISTOTLE seem to justify what has been said of *humidus*, *aridus* and *siccus*, and will throw light on what is afterwards to be said of *madidus*. Κράνυον γαρ, το τελεως ξηρον, οἵτι και πεπηγεναι δι' ελλειψιν ύγροτητος.
—αντικειται γαρ τη ξηρω και το ύγρον και το διερον—και διερον μεν εσι
το εχον αλλοτρια ύγροτητα επιπολης· βεβεγμενον δε το εις Σαθος· ξηρο
δε, το επερημενον ταυτης—ύγρον μεν γαρ εσι, το εχον οικειαν ύγροτητα ει
τω Σαθει.—“ Aridum enim est quod omnino siccum est, adeo
“ ut humiditate deficiente corpus etiam concreverit. Adversa-
“ tur siccus humidum et madidum. Madidum enim est quod
“ habet humiditatem non a se ortam, superficie tenuis. Humi-
“ dum vero quod introrsus habet; Siccum autem quod hac va-
“ cat. Humidum enim est quod in penitiore parte propriam
“ continet humiditatem †.”

THE term *uvidus* is applied to the earth as well as *humidus*, but the quality suggested by it is different. Thus, COLUMELLA says, “ Nisi præpingui et *uvida* terra §.” By *uvida*, he does not mean the poor soil that is swampy, and generates water which it emits at its surface, but such as, though moist, is rich and loamy.

UVIDUS is transferred from those vegetable substances to which it is originally applicable, to others which strongly resemble them, by imbibing and retaining a quantity of moisture.

— me

* Plin. 12. 12. 26.

† Αξιοτελ. περι γενετων και φθορων. κηφ. 6.

‡ Cic. de Sen. 10. 83. b.

§ Lib. 7. cap. 3.

— me tabula facer
Votiva paries indicat uvida,
Suspendisse potenti
*Vestimenta maris deo **.

The mariner's clothes hung up in the temple of NEPTUNE are here supposed to have been soaked in the sea, and, like the grape, to contain a quantity of moisture, which would either free itself by evaporation, or might be easily wrung from them.

Uvidus hiberna venit de glande Menalcas †.

Longas O utinam, Dux bone, ferias
Præstes Hesperiaæ, dicimus integro
Sicci mane die: dicimus uvidi,
Cum sol oceano subest ‡.

In the last of the above examples, it appears, that *uvidus* differs from *bumidus*, in being applied to mind, as well as matter, and in suggesting the notion of drunkenness. This application seems to be founded on the kind of the drink which produces the intoxication. The ampliative adjective “*vinosus*,” denotes the quality of being a lover of wine, and *uvidus* as taken in the passage last quoted, denotes having drunk it plentifully, and feeling its effects.

MADIDUS differs from *bumidus* and *uvidus*, in expressing moisture that is not contained in the substance specified, but which is adventitious, and affects its surface. It agrees also with the last term, in supposing it void of the capacity of supplying the waste of moisture, in whatever way that waste may be effected. It applies to the extrinsic or superficial wetness of a substance, whether this is produced by a natural or an artificial cause.

* Hor. Car. I. 5. 14.

† Hor. Car. 4. 5. 37.

‡ Virg. Ec. 10. 20.

cause. In the primitive and literal applications of *humidus* and *uvidus*, they denote subjects furnished by the hand of nature with the attributes they respectively denote. Thus, moisture is naturally inherent in humid ground and in a ripe grape. Dryness, again, is the natural state of that which, being accidentally wet, is then said to be *madidus*.

— nam dum se continet Auster,
Dum sedet et siccatur *madidas* in carcere pennas,
Contemnunt medium temeraria lina Charybdin *.

“ Sed ille scripsit ad BALBUM illum fasciculum epistolarum totum “ *fibi aqua madidum redditum esse* †.” This packet was so much wetted from an accidental cause, that CICERO tells us the letter addressed to him was not legible. A superficial wetting would produce this effect. It is not necessary to suppose, that the *fasciculus* would be drenched like the *vestis uvida* before mentioned, which, from the porousness of the materials, had absorbed a quantity of water, and retained it as the skin of the grape does its juice.

MADIDUS agrees with *uvidus*, in being applied to persons as well as to things, and in suggesting the idea of drunkenness. He who was said *madere vino*, was understood to be “ *vino rigatus*,” that is, bedewed with wine.

Faciam ut sit *madidus* sobrius ‡.

The wit of the comic poet here rests upon his apprehension, that *madidus* refers to an external or superficial wetting in its primitive sense.

WHILE

* Juv. Sat. 5. 98.

† Plaut. Amph. 3. 4. 18.

‡ Cic. ad Quint. Frat. 2. 14.

WHILE *madidus* agrees with *vividus* in the respect just mentioned, it differs from it in denoting proficiency in science and in letters.

*Si quis Cecropiæ madidus Latiæque MINERVÆ
Artibus, et vera simplicitate bonus* *.

*Non ille quanquam SOCRATICIS madet
Sermonibus te negliget horridus.*

*Narratur et prisci CATONIS,
Sæpe mero caluisse virtus* †.

The critics have very properly explained *madidus* and *madere*, in the above and other such passages, by means of the term *imbutus*. Both the adjective and the verb refer to a vessel tinctured in respect to colour, taste, or smell, by a fluid with which it was wet when made to contain it.

COMMODUS, OPPORTUNUS, TEMPESTIVUS, agree in denoting the suitableness of objects or events to those interested in their nature, but differ in respect to the circumstances upon which that quality is founded. The first comes from *con* and *modus*, and denotes, that the thing specified is neither more nor less than it should be, and possesses an inherent aptitude for some purpose to which it is just adequate. In the original application of *commodus*, it denotes the agreement of things as being adjusted by one common standard. Thus, when HORACE says,

Miscentur cyathis pocula commodis ‡,

he means, that those "cyathi" were neither more nor less than they should be. In consequence of this equality, each guest

got

* Martial. 1. 40.

‡ Car. 3. 19, 12.

† Hor. Car. 3. 21. 9.

got that share of the wine which was, on the one hand, sufficient to excite his vivacity, without producing, on the other, too quick an intoxication. When PLAUTUS also says,

Viginti argenti *commodas* minas *,

he means, that the pieces were of a regulated weight.

WHEN *commodus* is applied to persons, it denotes their agreeableness as companions. It implies a mental temperament, which is mild from the restraint of sentiments, that always give disgust when extravagant. It accordingly signifies that pliancy of character which, without servility, endears a person to those with whom he lives. “ Nemo CATONE proavo tuo “ *commodior*, comior, moderatior fuit ad omnem rationem hu- “ manitatis †.”—“ Qui antea *commodis* fuerunt moribus, eos “ prosperis rebus immutari †.”

WHEN *commodus* is applied to events, it denotes, that they are agreeable, as being commenfurate to the wishes of those concerned in their occurrence. It regards that medium, the happiness of which would be destroyed either by defect or excess. “ Nihil potest fieri nec *commodius* nec aptius, quam ut “ scribis. Ex literis tuis, ea quæ in agro Piceno gesta sunt cog- “ novi *commodiora* esse multo, quam ut erat nobis nunciatum §.”

OPPORTUNUS differs from *commodus*, in having no natural reference to the adjusted quantity of that which is specified, and in regarding the suitableness as founded on the exigency or pressing necessities of those to whom the objects or events present themselves. It comes from *ob* and *portus*, and its force rests on the agreeableness of any harbour to a mariner when contending with a storm. The suitableness implied in *opportunitus*

may

* Afin. 3. 3. 135.

† Cic. pro Murzen. 66.

‡ Cic. Am. 106. b.

§ Cic. Ep. Att. 13. 37. & 126. a.

may be discerned either between objects and objects, or between events and the times and places of their occurrence.

*Nihil homini amico est opportuno amicius**.

"Ceteræ res quæ expetuntur *opportunæ* sunt singulæ rebus fere "singulis: divitiæ ut utare: opes ut colare: honores ut lau- "dere: voluptates ut gaudeas †." In the first of the above examples, the friend may present himself either accidentally, or in consequence of being sought for; in the last, the different things mentioned are all the objects of an intended and a keen search. Both examples imply, that the occurrence or the attainments are highly seasonable, from the circumstances of the person concerned. "Ad hosce proferendos, et tempus et "locum *opportunitissimum* elegi ‡." In this last example, we see the suitableness between the event and both the time and the place of its occurrence.

TEMPESTIVUS denotes the suitableness of objects and events from neither of the circumstances already mentioned, but from the former being in their state of full maturity, and the latter occurring at their proper season. As applied to objects, *tempestivus* supposes them belonging either to the animal or the vegetable kingdom, and of course having a progress toward perfection, and afterwards a decline. "Vindemia *tempistica* §."

*Aut tempistica sylvis evertere pinum **.*

Tandem define matrem,
Tempistica sequi viro ††.

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q

WHEN

* Plaut. Epid. 3. 3. 44.

§ Colum. 11. 12.

† Cic. de Am. 100. 6.

** Virg. G. 1. 256.

‡ Plin. lib. 8.

†† Hor. Car. 1. 23. 11.

WHEN *tempestivus* is applied to events, it supposes them either as returning in a regular vicissitude, or as happening at their proper period, and of course being well-timed. “Quam
“ *tempestivos* autem dedit, quam salutares non modo hominum,
“ sed etiam pecudum generi, iis denique omnibus quæ oriuntur ex terra, ventos etesios? Quorum flatu nimii temperantur
“ calores *.”—“ Ego vero propter sermonis delectationem *tempestivis* quoque conviviis delector †.”

Et tempestivum pueris concedere ludum ‡.

NAVIS, RATIS, CYMBA, SCAPHA, LINTER, agree in denoting a machine for conveying both persons and the subjects of trade by water from one place to another, but differ in respect to the size or the construction of that species, to which each can be properly applied. The first indeed is a generic term, applicable to a vessel of any kind, of whatever dimensions, or however formed.

Navem agere ignarus navis timet §.

The poet has here no intention to specify the kind of ship, as the danger from ignorance is the same in all kinds. “Confitetur cit optime cursum *navis*, quæ scientissimo gubernatore utitur **.”

THE generality of the term *navis* is often limited by the application of adjectives, which mark the use of particular species; as, *Navis longa, marina, fluvialis, piscatoria, oneraria, actuaria, &c.*

RATIS differs from *navis* in denoting the rudest vehicle to which a person can commit himself on water. The poets sometimes

* Cic. N. D. 52. b.

§ Hor. Ep. 2. 1. 114.

† Cic. de Sen. 14.

** Cic. in Ver. 244. b.

‡ Hor. Ep. 2. 2. 142.

times use *ratis* as a general term, but the prose-writers never do. The term expresses a raft, formed by the junction of a few beams, which can be used with safety only in smooth water. It had at first been but a floating platform, and when improved a little, got the appellation of *cava*.

Ipsa vides cœlum pice nigrius et freta ventis
Turbida, perque *cavas* vix adeunda rates *.

BOTH FESTUS and ISIDORUS support the account now given of *ratis*. “*Rates* vocantur tigna inter se colligata, quæ per “ aquas agantur.”—“*Rates* primum et antiquissimum genus “ navigii e rudibus tignis asseribusque consertum.”

IN the two following instances, CICERO and LIVY seem to justify the distinction made between *navis* and *ratis*. “*Cum aut “ navibus aut ratibus conarentur accedere* †.”—“*Navibus ab “ HANNIBALE incensis, rates ad trajiciendum in magna inopia “ materiæ ægre comparabat* ‡.” When any reference is made to *ratis* as the subject of a simile, it is always regarded as denoting a rude vessel, capable of giving but very imperfect security. “*Tanquam ratis in mari immenso, nostra vehitur “ oratio* §.”

CYMBÆ differs from *ratis*, in referring to a vessel fabricated with more art, and that is always of a small size. It denotes a boat, such as is used upon a ferry or lake, but so formed as to give all the security to be expected from its dimensions.

Non ideo debet pelago se credere, si qua
Audet in exiguo ludere *cymba* lacu **.

q 2

CYMBÆ

* Ov. Ep. 17. 7.

† Cic. Tus. Q. 164. a.

‡ Cic. in Ver. 236. 5.

** Ovid. Trist. 2. 329.

§ Liv. cap. 36.

CYMBA is often applied to the boat in which CHARON wafted the souls of the dead across the Stygian lake.

Scandenda est torvi publica *cymba* senis *.

This boat, we are told by VIRGIL, was so small, that it could hardly support the body of AENEAS.

— gemuit sub pondere *cymba* †.

SCAPHA differs from *cymba* in denoting a yawl that attends a ship for the convenience of those who belong to it. As coming from the Greek verb *σκαρπεῖν*, it seems originally to have signified a canoe, or boat formed out of the trunk of a tree; but the circumstance which distinguishes it, is that above mentioned. “ Ut dominus navis cum idem gubernator esset in “ *scapham* confugeret, et inde funiculo qui a puppi religatus “ *scapham* annexam trahebat, navim quoad posset moderare-“ tur †.” — “ Quum merfiffent quaffas naves in alto, exceptis “ in præparatas *scaphas* nautis §.”

LINTER differs from *scapha*, in implying no connection between it and a larger vessel, and in denoting a “ *navis fluvia-
lis*,” or wherry used only on fresh water, such as that of rivers and lakes. They agree as to the original mode of their formation, that is, as being *μορέψιλα*, or hollowed out of a solid piece of wood.

— durum procudit arator
Vomeris obtusi dentem, cavat arbore *lintres* **.

Partitur *lintres* exercitus; Actia pugna.
Te duce per pueros hostili more refertur,
Adversarius est frater, lacus Adria ††.

“ Qui

Propert. 3. 18. 24.

AEn. 6. 413.

Cic. de Inv. 81. 4.

§ Liv. 23. 3.

** Virg. Georg. 1. 261.

†† Hor. Ep. 1. 18. 61.

" Qui cum non impetrasset, ut insulam in lacu prælio vende-
" ret, repente *in tribus* in eam insulam, materiam, calcem, cæ-
" menta atque arenam convexit *."

COMES, **SATELLES**, **SOCIUS**, **SODALIS**, agree in denoting a connection that subsists between one person and either one or a number, but differ as to the end for which this connection is formed, and the conditions upon which it is maintained. *Comes* is properly applied to one who voluntarily gives his attendance to another as to his superior. That parity which subsists between a number of *comites*, does by no means take place between them and their patron. Reciprocal obligations are understood to subsist between the parties, but the duties vary according to the respective situations of each. The attendance of the *comites* is supposed to be given at all times, but especially when the superior is moving from one place to another, and the attachment of his followers is roused by a sense of his danger.

— tibi parvula res est
Arcta decet fanum *comitem* toga †.

" CREUSA matre, Ilio incolumi, natus, *comesque* inde paternæ:
" fugæ ‡."—" Quanta illi in oratione majestas? Ut facile Du-
" cem populi Romani non *comitem* dices §."—" Non enim
" paruit ille TIBERII GRACCHI temeritati, sed præfuit: nec se
" *comitem* illius furoris, sed ducem præbuit **."

SATELLES differs from *comes* in implying, that the difference of rank is greater between the superior and his attendants; that the latter do not necessarily act from affection, and give their attendance as the instruments of protection or pageantry, or of both.

Aurum per medios ire satellites
Amat — ††.

* Cic. pro Mil. 27.

† Hor. Ep. 1. 18. 29.

‡ Liv. 1. 3.

§ Cic. Amicit. 113. b.

** Cic. ibid. 103. b.

†† Hor. Car. 3. 16. 9.

" Janitores:

" Janitores ducentos in annos singulos stipatores corporis con-
" stituit, eosdem ministros et *satellites* potestatis *."

SOCIUS differs from the two former words in implying, that parity of rank subsists between the parties, and that each has an equal right to enjoy the good that belongs to their common concern, and is under an equal obligation to take a share of its evils. The *socius* is actuated, not by respect to a superior, but by love to a party, in the success of which he feels that he has an interest. " Nam *socii* putandi quos inter res communicata
" est †."—" Sed me movet unus vir, cuius fugientis comes,
" rempublicam recuperantis *socius* videor esse debere ‡." The sentiment of respectful affection expressed towards the fugitive in adverse times, is held the foundation of a claim to become his ally in times that were prosperous.

IT is to be observed, that the personal attendance necessary to preserve the relation between *comites* and *satellites*, and those with whom they are respectively connected, may be dispensed with in the case of *socii*. When the terms of the alliance are defined, any mode of communication is sufficient to maintain it. The same persons, too, may, at the same time, be considered both as *socii* and *comites*. In the one case, they are regarded as having a common fate with their leader, and in the other, as associating with their friend in a common adventure. Thus, TEUCER is made to address his *comites*, or followers, by the endearing appellation of *socii* also.

Quo nos cunque feret melior fortuna parente
Ibimus, O *socii comitesque* §.

SODALIS agrees with *socius* in supposing those connected to be upon an equal footing, but differs from it in respect to the

* Cic. Rull. 72. 6.

† Cic. Ver. 3. 50.

‡ Cic. Ep. Att. 132. 6.

§ Hor. Car. 1. 7. 25.

the principle leading to the association, and to the purpose of maintaining it. Men become *sodales*, not to promote their interest, but to enjoy society. Their alliance is formed and preserved for their mutual entertainment; it is never understood to lead to any thing disagreeable, and it may at any time be abandoned without the violation of compact. “*Et tempestiva convivia, et per vigiles ludos, advocata sodalium turba, solutus atque affluens agerem* *.”

POMPEI meorum prime *sodalium*,
Cum quo morantem sæpe diem mero.
Fregi — +.

“ Primum habui semper *sodales*. Epulabar cum *sodalibus* omnino modice †.”

COPIA, ABUNDANTIA, UBERTAS, agree in denoting plenty, but differ according as this refers to the removal of every want, to what is more than sufficient for this purpose, or to the regular supply of a necessary waste. *Copia*, which seems to be compounded of *con* and *opes*, denotes an assemblage of the means fit for effecting any purpose. It stands opposed to *inopia*, which denotes the absence of such means, and which is also derived from the same root. “*Nec in summa inopia levis esse senectus potest ne sapienti quidem, nec in summa copia insipienti non gravis* §.” — “*Rerum copia verborum copiam gignit* **.”

— obnoxii ambo

Vobis sumus propter hanc rem, cum quæ volumus nos:
Copia est, ea facitis nos computes — ††..

The

* Quint. Decl. 9. 10.

§ Cic. de Sen. 78. b.

+ Hor. Car. 2. 7. 5.

** Cic. Or. 3. 123.

‡ Cic. Sen. 86. a.

†† Plaut. Cap. 2. 1. 21.

The obligation mentioned in this last example rests upon the complete supply afforded in respect to the object desired. It must not, at the same time, be understood, that the supply denoted by *copia*, is always much more than adequate to the exigency. The term cannot be applied where there is any want, but it occupies all the interval between the mere absence of this and that exuberance, which suggests a quantity more than adequate to any possible demand. “*Minimam copiam poetarum egregiorum extitisse* *.” Though there was no want of distinguished poets at the period referred to, yet there was the smallest number to which *copia* could be applied. “*Ex majore copia nobis quam illi fuit eligendi potestas* †.” The *major copia* is here opposed to the *minor*, and the existence of that latitude clearly proved, in which it has been said that the substantive is taken. In the one case, *copia* denotes what ministers to the gratification of the caprice, and in the other, to the full supply of the wants of mankind.

ABUNDANTIA differs from *copia*, in denoting greater plenty, and in implying that the object to which it is ascribed, possesses more than sufficient means for satisfying any want. It comes from *ab* and *unda*, and has at first referred to a river when overflowing its banks.

Præfertim incertis si mensibus, amnis *abundans*
Exit, et obducto late tenet omnia limo †.

“Circumfluere omnibus *copiis* atque in omnium rerum *abundantia* vivere §.” In the climax formed in this sentence, the last substantive denotes something beyond the satisfaction of want. It expresses somewhat to spare, which would be lost if not used. “Non erat *abundans*, non inops tamen **. CICERO
here

* Cic. de Or. 85. 6.

§ Cic. de Am. 52.

† Cic. de Inv. 62. 6.

** Cic. in Brut. 238.

‡ Virg. Georg. 1. 115.

here suggests the existence of that interval, in all the different points of which *copia* finds a place. There is said to be on the one hand nothing superfluous, and on the other nothing deficient.

WHILE *abundantia* denotes a greater plenty than *copia*, yet that implied even in it, may be occasionally carried to excess, and to what in English is styled "superabundance," when the quantity is so great, as to be cumbersome and useless. "Ludos et inania honoris modo rationis atque *abundantia*" "duxit, uti longe a luxuria ita famæ propior *." In the conduct of AGRICOLA, there was on the one hand no blameable œconomy, and on the other no needless waste, that might be termed extravagance. "Non illa quidem *luxuriosi* hominis sed " *abundantis* †."

UBERTAS differs from the two former words, in referring, not to the absolute quantity alone existing at a specified time, but to the regular supply of a necessary waste, and in supposing the plenty denoted by all the terms uniformly continued. The adjective *uber*, of which it is an abstract, takes its power from the substantive *uber*, signifying that which contains the milk of an animal giving suck. "Nuper nati mammas appetunt, earumque *ubertate* saturantur ‡." From denoting the regular supply of this juice, designed for supporting the young of animals, it has been transferred to another operation of nature, visible in the fertility of fields and trees. " *Ubertatem* " frugum et fructuum a diis se habere §."—"Facile est remedium *ubertatis*, sterilia nullo labore vincuntur **."

LAST of all, *ubertas* has been figuratively applied to that inexhaustible store of sentiment and expression which forms a distinguished

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* Tac. Agric. 6.

§ Cic. de N. D. 77. 6.

† Cic. Phil. 2. 66.

** Quint. 2. 4.

‡ Cic. de N. D. 52. a.

stinguated orator; and in the example subjoined, the metaphor begun in the first member of the sentence, is happily supported in some of the words that follow. “ *Omnis enim ubertas, et quasi sylva dicendi ducta ab academicis est.* ”*

* Cic. Orat. 198. 4.

S.

III. *On the ANCIENT HELLENES.* By DAVID DOIG, LL. D.
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[*Read Nov. 15. 1790, and April 18. 1791.*]

IN some other dissertations, I have endeavoured to investigate the original country of the *Iones*, *Dores*, *Æoles* and *Acbæi* or *Achivi*; and have, I hope, shewed, that none of these tribes were *aborigines* of Greece. In this paper, I shall trace the origin of the *Hellenes*, a people who, in process of time, became so considerable, that all the other septs and petty clanships of that nation were proud of being called by that venerable name. It was the distinction which they deemed the most honourable; and *Ἐλλῆς* and *Βασιλεῖς*, at one time, comprehended the whole human race.

THE more ancient Greeks, however, as well as the people of the east, knew nothing of this appellation. The Italians were equally strangers to it. The ancient name by which the Greeks distinguished themselves, and by which they were known to the western nations, was that of *Graii* or *Græci*, which, it is pretended, they derived from Γραιος, *GRAIUS*, a very ancient King of Thessaly. This very ancient personage was probably an imaginary chief, who owed his creation to the fertile fancy of the Grecian genealogists. The Greeks themselves must have abandoned this denomination at an early period, since it never

occurs in HOMER, and indeed very rarely in other Greek authors. ARISTOTLE, speaking of the inundation of Thessaly in the reign of DEUCALION, is, I believe, the most ancient writer who mentions that name*.

PLINY, in the beginning of his description of Greece, informs us, that *Gracia* was the name given by the Romans to that region. “*Ab Isthmi angustiis Hellas incipit, nostris Gracia appellata †.*” The word *Gracia* was peculiar to the Romans; for we never meet with the word *Γεανία* in any Greek author. As HOMER never uses the word *Γεαῖκοι*, we may justly conclude, that it was become obsolete in his days. Whence then did the Romans borrow this Gentile appellation? According to DIONYSIUS of Halicarnassus ‡, a considerable body of the Pelasgi, expelled from Thessaly by DEUCALION, after hovering some time about Dodona, crossed over into Italy, and possessed themselves of a considerable part of that country. These Pelasgi carried over the name *Γεαῖκοι* and *Γεανία* into Italy at that early period, and the Romans, a people by no means fond of innovations, retained it to the last.

HESYCHIUS informs us, that *Γεα* signifies the earth, and likewise CERES. Every body knows, that the ancient Heathens looked upon the earth as the most ancient of beings. By consequence,

* Οὐκέτι γένει οἱ Σιλλοὶ οὐτανδε, καὶ οἱ παλαιμόνοι τοῦτο μὲν Γραικοὶ, τούτο δὲ Ἑλληνες. Meteor. Lib. i. cap. 14. LYCOPHRON, an author who affects the antique style, calls PROTESILAUS Γραικὸν αριστόν, Alex. 532. and in another place he says,—Γεαῖκοισι, μαντεῖοις τοις Ἑρίκ-Σινοις. Ib. 138. Upon this place TZETZES has the following observation,—Γεαῖκος γένει πρωτίστορος οἱ τῆς Ἑλλάδος παλαιύτεροι. GEORGIUS SYNCELLUS to the same purpose,—Ἐλλαῖς οὐς Διοκαλιανος ἴγνωσθετο αφ' Ἀ' Ἑλληνες οἱ Γραικοὶ ματικλεθησαν. Edit. Par. p. 153. Edit. Ven. p. 122. HESYCHIUS is of opinion, that the word was changed by the Romans. Παντες, Ἑλλην. Ρωμαιοι δε το γρεοθείτες Γραικοὶ φασι. In voce Ραικό. But this conjecture is evidently false. See ALBERTI's Edit. of HESYCHIUS, Vol. ii. p. 1098.

† Lib. iv. cap. 7.

‡ Lib. i. p. 13. Edit. STEPH.

sequence, the Greeks employed a word derived from the oriental name of that element, to signify the *beginning*, and CERES was the same deity with TELLUS, or the earth. In Greek, the word Γεαν, nearly the same with *grai* or *grau*, signifies *an old woman*. Indeed, *grai* and *grau* are actually the same; for the ancient Greek alphabet had no *upsilon*. The words Γεαιοι and Γεαικοι, according to this deduction, imported the original inhabitants of Greece, and was applied to them by the Pelasgi, in order to exhibit this very character. Every body knows, that the mythologists of Greece made no scruple to forge imaginary personages, upon every occasion, when they found themselves embarrassed in tracing out the progenitors of a nation. Thus, according to them, MEDEUS was the father of the Medes, PERSEUS of the Persians, PHOENIX of the Phœnicians, SYRUS of the Syrians, &c. According to the same arrangement, GRAIUS, if he was not the father of the Greeks, was at least the father of their Gentile name. HELLEN, ION, DORUS, ÆOLUS, ACHÆUS, were beings of the like equivocal generation.

HOWEVER far and wide the term *Hellas* came to be diffused afterwards, it was at first confined to one small city of Thessaly. It lay in Phthiotis, a small district of that country, toward the south. According to STRABO, some were of opinion, that Phthia, Hellas, and Achaia, were the same. Φθιας τε, οι μεν την αυτην ενωι τη Ἑλλαδι και Αχαιᾳ*. And a little after, he adds:—" Now those who say so, shew you, about sixty stadia " from their city, the ruins of a city which they believe to " have been *Hellas*, and near it two fountains, the one called " Messelis and the other Hyperiea." He goes on to inform us, " that the people of Melitæa alleged, that Hellas being situated " on a low ground beyond the Enipeus, the inhabitants, pro- " bably on account of the unhealthiness of the situation, de- " serted it, and went over to their city †. The author of the *Brevia Scholia* on the Iliad is of the same opinion. " Not in, " deed

* STRABO, p. 431.

† P. 431.

"deed all the Thessalians, but only those who dwelt in the
"city of Hellas *." Thus it appears, that the Thessalian Hellas was a very ancient city of the small district of Thessaly called Phthiotis, and that lay in the neighbourhood of the river Enipeus.

BUT the Hellas just now described was by no means the original one called by that name. We learn from ARISTOTLE the following circumstances †: "For this deluge, says he, happened chiefly about the district of the ancient Hellenes, and that near the city Hellas. Now, that city lay near Dodona, on the Achelous; for this river hath often changed its name. The Selli inhabited that canton. These were at that time called *Græci*, and now are denominated *Hellenes*." Here then we have discovered the original *Hellas*, the residence of the *Selli* or *Helli*, who were first called *Helladians*, then *Γερικοὶ*, and last of all *Hellenes*. These *Helli* or *Selli* were the original *Hellenes*. From them the Gentile name, that afterwards became so famous over a great part of the world, was derived, and not from *HELLEN*, the fictitious son of *DEUCALION*.

LET us now see who these *Helli* or *Selli* were who dwelt about the Thessalian *Hellas*, and from whom, we hope to make it appear, that the later *Hellenes* were denominated. STRABO, in his description of Epirus, gives the following account of that remarkable people ‡. "Now, concerning Dodona, that the people who dwelt about the temple were Barbarians, even HOMER himself has inferred from the peculiar austeries of their manner of living §: They sleep, says he, on the bare ground."

* Ad Iliad. ix. 437.

† Καὶ γὰς ἦτος πάρι τοῦ Ἑλληνικοῦ εὑρέσθαι μαλισταὶ κ. τ. λ. Meteor. lib. i. cap. ult.

‡ Πλεῖ δὲ Δοδωνῆς κ. τ. λ. Lib. vii. p. 328.

§ Iliad. xvi. 233. SOPH. Trach. 1180.

"ground with their feet unwashed. But whether we ought to call them *Helli*, as PINDARUS does, or *Selli*, as they imagine the name stands in HOMER, the ambiguity of the orthography does not suffer us to determine. PHILOCHORUS tells us, that the district about Dodona, as well as that of Eubœa, was called *Hellopia*: For HESIOD speaks thus: *There is a certain place called Hellopia, diversified with dales and meads. Here, in the utmost corner, is built the city of far-famed Dodona.*" From the concluding part of this quotation, it appears, that the country about Dodona was called *Hellopia*, as well as *Hellas*, which are indeed names nearly of the same import, as we hope to make appear in the sequel. With respect to the difference of the terms *Helli* and *Selli*, we may observe, that the consonants *b* and *s* being both aspirates, are often used promiscuously in different dialects, and that of consequence the *Helli* of PINDAR and the *Selli* of HOMER were one and the same people.

From the above quotation it plainly appears, that the original Hellas was a city in the neighbourhood of Dodona; that the district where it stood was called *Hellopia*; that the inhabitants were called *Helli* and *Selli*; and that these were the ministers of the temple there established. The Thessalian Hellenes were a colony of the Dodoneans, who emigrated from that canton at a very early period. The Pelasgi were at that time masters both of Thessaly and Epirus. Under their protection the *Helli* erected the oracle of Dodona *. With them a numerous body of those people found a sanctuary when expelled from Thessaly by DEUCALION and the Curetes †. It was then natural enough for the superfluous numbers of the Epirotic *Helli* or Hellenes to emigrate to Phthiotis in Thessaly, and to colonize a part of that country, especially as it was situated at no great distance from their native seat, and was then in the possession of these

very

* HEROD. Lib. ii. cap. 52.

† DION. Halic. Antiq. Rom. Lib. i. p. 13. Edit. STEPH.

very people under whose protection, and by whose permission, they had formed their original establishment at Dodona. This detail acquires farther confirmation, when it is considered, that the city which they built in Phthiotis was called Hellas, after the name of their metropolis, in the neighbourhood of Dodona. Indeed, it is highly probable, that there was a Dodona in Thessaly as well as in Epirus. This was the opinion of PHILOXENUS, a very ancient writer, quoted by STEPHANUS BYZANTINUS *, though the author last quoted condemns that opinion. As PHILOXENUS was much more ancient than the Byzantine, the probability is, that truth lies on his side. We therefore conclude, that the Thessalian Hellas was built by a colony of emigrants from the city of that name near Dodona in Thesprotia, a district of Epirus.

THE inhabitants of Hellas and its neighbourhood were called *Hellenes*. Accordingly, STRABO actually so denominates the inhabitants of that city. Εξ δε της Ἑλλαδος εν ταχειᾳ χωριῳ ζειμενης, εις την ιαυτων μετοικησαι της Ἑλληνας †. I know that the Greeks ascribe the building of this city to HELLEN, the son of DEUCALION; but had this been the case, the city, according to the idiom of the Greek language, must have been denominated Hellenia, and not Hellas.

THESE Hellenes, in process of time, extended themselves over all the south part of Thessaly. HERODOTUS is clearly of opinion, that the Hellenes were a Pelasgic tribe. Speaking of the Pelasgi and these people, he expresses himself in the following manner:—Το δε Ἑλληνικον [εἴδιος] γλωσση μεν, επει τε εγενετο, αεικοτε τη αυτῃ διαχραται, ὡς εμοι καταφαινεται εναι, αποσχισθεν μετοι απο τη Πελασγικη, εον ασθενεις, απο σμικρη τε την αρχην ὄρμαμενον, αυξηται εις πληθος, των ειδυεων πολλων μαλισκα προσκεχωρηκοτων αυτω και αλλων ειδυεων, βαρβαρων συχνων ὡς δη, ὡς εμοι τε δοκει ‡. As this passage is of more than ordinary importance, I shall subjoin a li-

* In voc. Dodona.

† P. 432.

‡ Lib. i. cap. 58.

teral translation of it. "But the nation of the Hellenes, since ever it existed, continues, as far as to me appears, to use the same language; being a branch cut off from the Pelasgic stock, and weak and inconsiderable at the first, in a short time it increased into a multitude of people; vast numbers of the neighbouring nations in particular, and multitudes of other barbarians in general, having joined it, as I imagine to have been the case." According to this detail, the Hellenes were sprung from the Pelasgic stock, and were not so called from the fabulous **HELLEN**. Nor is it surprising that **HERODOTUS** should imagine, that these Hellenes were of Pelasgic extraction, when it is considered, that they lived among those people from the time of their first arrival in those parts, and were constantly under their patronage and protection.

HAVING thus endeavoured to prove, that the Hellenes of Thessaly were a colony of emigrants from the Helli or Selli of Epirus, in the neighbourhood of Dodona, let us try if we cannot discover who these people were, and from what country they emigrated, when they came to settle in those parts. We have already seen, that they were the ministers of the temple of **JUPITER** Dodoneus, and that they were an austere, ascetic, self-denied race of men. The origin of the temple of **JUPITER** at Dodona is accurately described by **HERODOTUS***. Its vocal oaks, prophetic doves, and tinkling kettles, have been minutely explained by a great variety of writers, both ancient and modern. It was situated in Chaonia†, a small territory of Epirus, which formerly belonged to Thesprotia, but afterwards to the Molossi. The temple itself lay at the foot of a mountain called *Tomarus* or *Tmarus*. As that mountain rose from the plain, somewhat resembling a palm-tree, I imagine the name is derived from the oriental word *Tamar*, which actually signifies

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* Lib. ii. cap. 54. et seq.

† STRABO, p. 328, 329.

a palm-tree. HERODOTUS tells us, that this was the most ancient oracle of all Greece. The same historian gives us an exact account of the tradition of the Egyptian establishment of that oracle *; a tradition "which," says he, "was authenticated by the priests of Dodona in my days."

IT appears plainly from HERODOTUS, that this oracle was instituted by a priestess from Egypt †, and that it was copied from that of JUPITER at Thebes, or DIOSPOLIS of Egypt. Both were originally consecrated to the sun, who was undoubtedly the primary JUPITER of the Pagan world. STRABO infers ‡, I believe not justly, from HOMER's account of the Selli who ministered in the temple of Dodona, that the original retainers of that establishment were men, and not women. HERODOTUS, who had a much fairer opportunity of discovering the genuine tradition, plainly intimates, that the person who first instituted the oracle, was one of the priestesses of the Egyptian Thebes. Though the Greek poet mentions only "the 'Selli, who lay on the ground with feet unwashed,'" it does not follow, that there were not likewise *Sellæ* of the like ascetic character. The same geographer informs us, "That in process of time, when DIONE was admitted to a share of that 'temple, three old women were appointed to officiate as her 'priestesses §.'" These female ministers were called *Peleiades*, which, in the language of Thessaly, signifies *doves* ||, and hence the origin of the fable concerning the oracular pigeons of Dodona.

HERODOTUS, who had conversed with the Egyptian priests upon the subject of the establishment of the oracle and temple of Dodona, informs us, in the passage above quoted, that they homologated the tradition of the Dodoneans with relation to

the

* Lib. ii. cap. 55, 56, 57.

§ P. 329.

† Ibid.

|| HESYCH. in voc. Πελασία.

‡ P. 329.

the certainty of that ancient fact. But it will scarce, I imagine, be supposed, that one single old Egyptian priestess had the address and courage to erect the oracle in question. Whatever the modern Greeks may have dreamed upon that subject, she must have had men as her co-adjudors in that operation. These co-adjudors were the original Sellii. These people were actually emigrants from Egypt and Phœnicia. As the Egyptians, in the earliest times, were averse to navigation, all the Egyptian chiefs who brought colonies into Greece, were obliged to transport themselves on board Phœnician vessels, and of course generally imported a mixture of these people. The fact then was,—The original inhabitants of the neighbourhood of Dodona were a colony of Egyptians and Phœnicians *. The Egyptians were, however, the leaders in that emigration. Some part of these belonged to the sacerdotal tribe, and had been originally ministers of the temple of NO-AMMON, Thebes or Diospolis. These probably consisted of both sexes, and these actually founded the oracle and built the temple of JUPITER Dodonæus, in imitation of that of the same Deity in Egypt. Like the priests of Delphi of a later date, they employed a priestess to publish the oracles to those who consulted them. After some years, DIONE, or the Moon, was admitted to a participation of the worship there established. Upon this occasion, three additional priestesses were appointed to minister to that divinity.

FROM this deduction, it appears obvious, that the Helli or Sellii of Dodona were originally a colony from Egypt and Phœnicia; that the leaders of this colony were Egyptians from Thebais of Egypt; that these brought in their train some of the priests of JUPITER at Thebae, or were perhaps themselves a swarm discharged from that seminary; that from them the region about Dodona was called *Hellas*, and the natives *Hellenes*;

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that

* I say Phœnicians, because most of the names of the objects about the temple appear to be Phœnician.

that from them were descended the Thessalian Hellenes, whose name was, in process of time, adopted by all the nations of Greece.—Let us now try if we cannot produce something still more plausible in confirmation of this hypothesis.

THE original term *Hel* signifies *light, brightness, splendour*. Perhaps it is the same with the word *El*, without the aspiration, which is one of the epithets of the true GOD among the Hebrews; for “God is light, and in him is no darkness at all.” When the luminaries of heaven became the objects of religious worship among the ancient Pagans, most of the names, titles and epithets which had originally belonged to the true GOD, were transferred to the solar light; consequently *El* or *Hel* became a title of the sun. Among the heathens, it was a prevailing practice to denominate the several classes of priests from the title of that deity to whom they respectively ministered. This point needs no confirmation. If then the Hellēi in question were originally priests of JUPITER, that is, the Sun, they were of course denominated from that deity. Another oriental word now presents itself, which, if admitted into the composition, will naturally produce the word we are endeavouring to investigate. In Hebrew, *En*, or perhaps *Ein*, signifies both an *eye* and a *fountain*. From a combination of the words *Hel* and *En*, (doubling the *l* in order to strengthen the sound), we have *Hellen*, which may signify, either the *fountain* of light, or the *eye* of light, both terms naturally applicable to the sun. The original import of the word *Hellen* was then, according to this etymology, *a worshipper or votary of the fountain of light, i. e. the Sun*. As a collateral proof of the justness of this etymology, it may be observed, that among the ancient Greeks, the word *Helena* was actually a name of the *moon**, and, by a parity

* The Greek word Σεληνη seems to be the very same with Ἔλεων, only changing the spiritus asper into Σ, according to the Æolic dialect. Σεληνη was also a name of the sun.

parity of reason, *Helenus* must have denoted the *sun*. The difference between *Helenus*, if you cut off the affix *us*, is next to nothing. But that the original word *Hellenes* actually imported *worshippers of the sun*, or at least of the *host of heaven*, will, it is hoped, appear obvious from the following observations.

IT is a well known fact, that the fathers of the Christian church have divided the early ages of the world into three epochs, which they have distinguished by the names of *Βαρβαρισμός*, *Σκυθισμός* and *Ἑλληνισμός*, *Barbarism*, *Scythism* and *Hellenism*. The two first we omit as foreign to our purpose; the last is a point of great importance towards establishing our position, and therefore its purport must be fully elucidated. It must indeed appear somewhat extraordinary, to find people talk of a Hellenic period as existing many centuries before the Hellenes of Greece had risen into existence. But these holy men were ignorant of the import of the name. They did not know, that the term *Hellen* imported a *votary of the sun*, the *Hel-En* or *fountain of light*, and intimated the very same thing with *Zabians*, or *worshippers of the host of heaven*. EPIPHANIUS fixes the rise of Hellenism to the age of SERUCH. “ RAGAM “ begat SERUCH, and then idolatry and Hellenism began “ among men *.” Hellenism was then coeval with SERUCH, many ages before the Hellenes of Greece. Indeed, EUSEBIUS and SYNCELLUS make SERUCH the author of the first apostacy from the true religion †. CEDRENU斯 makes Hellenism only as ancient as THARRA. “ And NACHOR begat THARRA; then “ was introduced the fabrication of images by the skill of “ THARRA ‡.” Here then we have the origin of Hellenism fixed to a very early period. This apostacy consisted in worshipping the host of heaven, the Hel-En, the fountain of light.

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* Vol. i. Her. i. cap. 6. p. 7.

† Vol. i. p. 15.

‡ Chron. p. 15. SYNCEL. p. 34.

Those who were addicted to that species of idolatry were called *Hellenim*, or *sun-worshippers*, and the appellation was probably fixed on them by those who persevered in the worship of the true GOD.

THE Babylonians, according to the most authentic accounts, were the first people who worshipped the host of heaven, and of consequence were the first Hellenes. This name they retained much longer I believe than is generally imagined. The prophet JEREMIAH, foretelling the overthrow of the Egyptians at Carchemish on the river Euphrates, introduces the auxiliaries of that army as exhorting one another in a speech to the following purpose: “ Arise, and let us go again to our own people, and to the land of our nativity, from the face (edge) of the sword of the *Jonim* *.” The Seventy translate the last clause, *Ἄπο προσωπῶν μαχαιρᾶς Ἑλληνικῆς*. Again, in another place †, we have the very same words translated in the same manner. It would be absurd to imagine, that the translators were so ignorant as to suppose that the Greeks were really intended in these passages. They could not but know, that the inspired writer alluded to the Babylonians; and that the Græcian Hellenes at that period, could have no manner of connection with the Babylonians. The fact is, they knew that these people had been often styled *Hellenes*, i. e. *worshippers of the sun*. They knew that this was a general appellation by which these people were known over all the neighbouring countries, and consequently applied it to them without the least hesitation. This account, in my opinion, furnishes a very strong presumption, that the Babylonians were the original Hellenes, and that this name was applied to them in consequence of their attachment to the worship of the sun.

JOHANNES Antiochenus styles the Midianites Hellenes. He calls JETHRO, the father-in-law of MOSES, *Αγχιερεὺς τῶν Ἑλλη-*

* Chap. xlvi. ver. 16.

† Chap. 1. ver. 16.

*vav**, big priest of the Hellenes. Of what Hellenes? Surely not of the Græcian Hellenes, but of the Midianitish, that is, of the Midianites who were worshippers of the sun, moon and stars.

ON the upper recess of the Arabian gulf, there was a city called *Elana*, and sometimes *Ailane*. On the opposite side are fountains, called by the Arabians *El-Ain* to this day, El-Ain, the very peasants of the neighbourhood know to import *fontes solis*, "the fountains of the sun." This fact again furnishes a very plausible argument in favour of the etymology propounded above.

THE invasion and conquest of Egypt by the Pastor Kings, is an event generally known, and as generally admitted. AFRICANUS † calls these people, Ποιμενες Ἑλληνες and Βασιλεις Ἑλληνες, "Hellenic shepherds and Hellenic Princes." It cannot be pretended, that those foreigners had the most distant relation to the Hellenes of Greece, except from the identity of name. No; they were only worshippers of Hel-an, "the fountain of light." For the same people are called *Auritæ* and *Oritæ*, from *Aur* and *Or*, originally *light*, *heat*, and, by a very common metonymy, *the sun*. Those intruders were probably addicted to the worship of the solar Deity, and were consequently styled Hellenes, *Auritæ* and *Oritæ*, that is, *Sunites*, or votaries of the sun. It then appears, that there were Hellenes in Chaldæa and Arabia at a very early period, (for I take it for granted, that the Pastors who invaded Egypt were Arabians); and in Midian; and that, from the import of the term, these Hellenes were so denominated from their being addicted to the worship of the heavenly bodies.

As there were Hellenes in the countries above mentioned in the very first ages after the flood, so it will appear by the following quotations, that there were Hellenes likewise in Egypt much about the same period of time. PHILO Judæus, in his

life:

* E. 76, 77.

† Apud SYNCCELLUM. p. 61..

life of MOSES, after informing his readers, that this legislator had been instructed, during his youth, in arithmetic, in geography, in hieroglyphics, adds, *τηνδε αλλην συγχωλιαν παιδειας, κ. τ. λ.* *, “the remainder of the circle of sciences he learned from ‘the Hellenes;’ not I suppose from the Hellenes of Greece, who, if they did exist at that early period, were still a race of barbarians, if not absolute savages; but from the Egyptian priests of that denomination, who had actually by that time established seminaries or colleges in several parts of Egypt, as early as the age of MOSES. The learned Jew was acquainted with the term Hellenes, but was ignorant of its import and signification. He is indeed grossly mistaken in his application of it; as is likewise CLEMENS Alexandrinus, who borrows it from him, and applies it to the same purpose †.

DIODORUS Siculus informs us, that the great OSIRIS, returning from his travels over most parts of the then known world, “instituted religious ceremonies, and founded schools of eloquence in Egypt. Of these he appointed HERMES the Prefect, who taught the Hellenes the rites relating to augury and divination ‡.” These Hellenes could be none other than the priests of Hel-En, that is, the Sun. The scholiast on APOLLONIUS’s Argonautics informs us from DICEARCHUS, that “SESON-CHOSIS, i. e. SESOSTRIS, was a zealous imitator of the Hellenic way of life §. The author’s meaning is no doubt, that he was an admirer of the austere manner of life practised by the Hellenes, or priests of the sun.

FROM the foregoing detail, we hope it will appear, that there were in the eastern parts of the world people called Hellenes, many ages before the Hellenes of Greece were known or existed; that this was originally not a Gentile, but a sacred or religious name; that it meant worshippers of the sun, and imported

* Vol. ii. p. 84.

‡ Lib. i. p. 16. Edit. STEPH.

† Vol. i. p. 413.

§ Lib. v. ver. 273.

imported much the same idea with the term *Zabian*; that in Egypt in particular there was a race of priests denominated Hellenes.—Let us now see to what purpose we mean to apply the foregoing observations.

We have already shewn from HERODOTUS, that the oracle of Dodona was an Egyptian erection; that the Helli or Sellii were the ministers of the Deity; that these Helli, afterwards Hellenes, were originally worshippers of the Sun, this planet being the primary JUPITER of the Greeks and Romans; that there was in the neighbourhood of that temple, a city called Hellas, the capital of a district called Hellopia; that the inhabitants of this canton were the original Hellenes of Greece; and, lastly, that the Thessalian Hellenes were a colony of emigrants from the last mentioned people. I should now proceed to investigate by what means the Hellenes of Thessaly grew so considerable, as to communicate their name to all the other communities of Greece. But before I enter upon this part of the subject, I shall take the liberty to hazard a few etymological conjectures, which, if admitted, will operate as collateral proofs of the hypothesis.

I OBSERVED in that part of this disquisition where I treated of the emigration of the Dodonean Helli, that, though the leaders of the colony were undoubtedly Egyptians, yet a number of Phœnicians were probably mingled with these emigrants. I shall now show, that most of the names connected with the temple and oracle, were actually Phœnician. Hellopia, the name of the canton around the temple, signifies a territory sacred to the sun and the moon. I have shewn above, that *El* or *Hel* was a name of the sun. *Ops*, *Opis*, *Upis*, was a Pelasgic name of the moon. In the Egyptian language, *Ob* was a name of the sun, and of course *Oba* became a title of his sister divinity. The consonants *b* and *p* being both labials, naturally pass into each other. Hence *Oba* or *Uba* became *Opa* and *Upa*. From *Hel* and *Opa* combined originates *Hellopa*;

whence the adjective Ἑλλωνία, with the word χώρα understood, intimating the Hellopian district. Again, *Hellas*, originally *Hellad*, as is obvious from the genitive *Hellados*, is compounded of *Hel*, light, splendour, &c. and *Ad*, an original name of the sun *. Hellas is then much the same with Heliopolis, the city of the sun. I have observed above, that *Tmarus* or *Tomarus*, the mountain overhanging the temple, might signify a palm-tree; but it may, with more probability, be compounded of the words *Tam*, integer, perfectus, and *Or* or *Ur*, heat or light. As it was an universal practice among the heathens to consecrate particular mountains to particular deities, and as the one in question lay contiguous to the temple of the sun, there can be no doubt of its being consecrated to that deity. The name *Dodona* itself I take to be a *vox hybrida*, compounded of the Greek word Δῶ, *domus*, and the Phœnician *Adon*, *dominus*; so that *Dodona* is the same with *Do-Adon*, the house of the LORD. The priestesses of the temple were called πελεια †. The Chaldean word *Peleb* signifies *serviuit*, *coluit*, and is upon some occasions actually employed to intimate the ministers of the house of God ‡. HESYCHIUS informs us, that the word πελεια in the Thessalian tongue signified a dove. This bird every body knows was sacred to VENUS among the Greeks and Romans, and to the Moon among the Syrians. Hence the priestesses were called πελειαι, because they ministered to DIONE in the temple of Dodona; and the pigeon had the same denomination, because it was sacred to the same deity. The Lacedæmonians called the temple of JUPITER in Dodona Ἑλλα §, a term evidently derived from *Hel*; and this was perhaps its original denomination. All these names are clearly of Phœnician extraction, nor are the etymologies obscure and equivocal. Every

* Macrobi. Sat. lib. i. cap. 23.

† HESYCH. in voce.

‡ See Ezra vii. 24. et alibi.

§ HESYCH. in voce Ἑλλα, καθεδρα, και Λιος Ιερου εν Δοδωνῃ. Λακωνια.

try one versed in etymological enquiries will, I am persuaded, admit them as probable, if not absolutely certain. Perhaps the Phœnicians constituted the more numerous part of the colony, and of course, though the leaders were Egyptians, the language of the majority, as is usual in such cases, might become the prevailing dialect. This too must have been mingled with the Pelasgic, which was probably a branch of the old Phœnician, or, at the most, very little different from that language. At the same time, it is generally allowed, that the Egyptian and Phœnician were no more than different modifications of the same tongue. Thus, it appears, that most of the names of places and persons connected with the temple of Dodona, as well as that of the temple itself, were of a Phœnician or Egyptian original; a circumstance which, in my opinion, ought to give additional weight to the arguments above adduced in confirmation of my position.—I shall now endeavour to point out the means by which the Hellenes of Thessaly grew so considerable as to communicate their name to all the other tribes of Greece.

THE Hellenes, when they arrived in Greece, brought along with them a large share of the culture and civilization both of Egypt and Phœnicia, at that time the two most polished countries upon earth. The emigrants from Dodona to Phthiotis no doubt carried along with them all the improvements of the parent colony. The inhabitants of Thessaly were at that time a race of barbarians. This assertion stands in no need of being authenticated by quotations. It is confirmed by the unanimous consent of antiquity. It is no hard matter to conceive how quickly a race of people, prodigiously superior both in arts and arms, must gain the ascendant among a rout of uncultivated, vagabond savages. Their manners, their dexterity, their skill in the mechanical arts, their policy, perhaps their superior courage and discipline, would naturally enough excite the admiration, and conciliate the affections, of all the tribes of

barbarians around them. The religious ceremonies which they introduced would render them venerable, and gain them multitudes of proselytes. The arts of augury, vaticination, and magic, would all co-operate to enhance their reputation. Agriculture, in that age little known, and still less practised in Greece, would be embraced with grateful hearts by the half-famished savages. They would look up to the authors of that blessing with the same sentiments which prompted the Roman poet to invoke **BACCHUS** and **CERES** benign :

*Liber et alma Ceres, vestro si munere tellus
Chaoniam pingui glandem mutavit arista.*

THE alliance of such a superior people would be eagerly courted, their manners would be imitated ; to incorporate with them by blood and affinities would be deemed honourable, and would, at the same time, be found safe, improving, and advantageous. Their nearest neighbours would be first drawn into the vortex ; the infection would gradually diffuse itself far and wide, till, in process of time, it extended its influence to all the oriental colonies at that æra newly established in Greece. Indeed, all these colonies looked upon themselves as brethren, as appears from the relation they all claimed to the family of their imaginary **HELLEN**. All those tribes might, in reality, look upon themselves as brethren, as they had emigrated from the same quarters, and were descended of patriarchs who actually stood in that relation to each other. Thus, the colony of the Hellenes, which, according to **HERODOTUS**, quoted above, was at the first weak and inconsiderable, by the accession of its neighbours and numbers of the barbarous nations around, became strong, populous, and considerable. The original name of *Graii* was forgot ; and first the cantons in the neighbourhood of Phthiotis, and afterwards, in a short time, almost all the septs of Greece, became *Hellenes*. Nothing less than the most exalt-

ed idea of the superior dignity and accomplishments of the Hellenes could, I think, have induced the circumjacent nations to abandon their respective Gentile denominations, and adopt that of an inconsiderable tribe of foreigners, but lately established among them. This opinion they must have excited by the means enumerated in the preceding pages.

THE ancient Egyptians, like the modern Chinese, were the most vain-glorious nation upon earth. Accordingly, HERODOTUS assures us, that they stigmatised all nations with the title of barbarians. Βαρβαρος δε παντας οι Αιγυπτίοι καλεντοι της μη σφιοις ὄμογλωσσους *. The Helladians or Hellenes brought this epithet with them into Greece, and, we believe, applied it literally to all those clanships around them which had not entered into alliance with them, or had not assumed their name. This epithet was at first confined to such of the nations of Greece as were not connected with the body of the Hellenes. In process of time, however, it became so widely extended as to produce the general division of mankind into Ἑλλῆνες καὶ Βαρβαροι, "Greeks and Barbarians." The influence of this distinction soon became irresistible among a conceited, vain glorious people. We learn from HERODOTUS, that the Athenians, who, according to him, were a Pelasgic tribe, changed both their name and language in order to become Hellenes. Το Αττικον εθνον εον Πελασγικον, ἀμα τη μετηβολη τη εις Ἑλληνας, και την γλωσσαν μετεμψαθε †.

BUT nothing contributed so much to extend the name and influence of the Hellenes, as the institution of the council of the Amphictyones. The institution of this patriotic and truly beneficial diet is generally ascribed to the wisdom and policy of one AMPHICTYON, a descendent of HELLEN, and a King of the Athenians ‡. That AMPHICTYON, if any such person ever ex-

isted,

* Lib. ii. cap. 138. in fine.

+ Lib. i. 57.

‡ M. GEBELIN, in his *Disc. Prelim. sur les Orig. Grecs*, has given a very exact account of the institution of this council. According to him, AMPHICTYON is

isted, was of the Hellenic race, cannot be doubted. The design, the usefulness, the arrangement of the institution, evidently breathe an Hellenic original.* It is not my intention at present to enter upon a detail of the functions or regulations of that celebrated court. I shall only observe, that the confederated states being twelve in number *, lodged their respective interests in the hands of that council or diet ; that this council was formed of a certain number of deputies from each of the allied cantons ; and that these cantons were at first situated around the city of Delphi in Phocis, where the *Amphictyones* held their assembly.

THE arrival of new colonies, time after time, from the coast of Phoenicia, which generally conquered, expelled, subjected, or extirpated the indigenous inhabitants of these countries, when they respectively made their descents, suggested the idea of the confederacy just mentioned. The Hellenes, in all probability, projected the alliance. It was a scheme suitable to the refined sagacity of a political and enlightened people. This supposition becomes the more plausible, when we reflect, that the arrangement is ascribed to a branch of the Hellenic family †. The Attics, ever prone to engross every thing great or meritorious to themselves, have, of course, dignified this ideal personage with the Royal title. He always appears in the list of their Kings. Self-preservation, the most powerful of all motives,

an imaginary person, which I think is highly probable. His etymology of the name is altogether fanciful; *μετ-* signifies *round, around, about*; and he imagines there might be an obsolete Greek verb *κτων, defendo*, whence the Latin *turo*, now *tueror*. After the same manner, we have *κτων, possedeo*, now *κτωπος, κτινω, occido*, &c. The *κ* is a mere adventitious prefix, calculated to invigorate the pronunciation. According to this etymology, the word *Amphictyones* will import persons whose office it was to protect all the circumjacent people.

* Authors only enumerate eleven. See more on this subject in the Appendix,
p. 153.

† Some make him the son of DEUCALION, others that of HELLEN.

tives, would readily determine the petty states lying between the modern Thessaly and Peloponnesus to prefs into the alliance. At the same time, gratitude for this benefit, as well as for those enumerated in the preceding pages, might naturally enough engage them to adopt the Gentile denomination of their gracious benefactors.

At first the Gentile name Hellenes was confined to the cantons connected by the Amphictyonic confederacy ; and these, as was just now observed, were all situated between the confines of modern Thessaly and the Isthmus of Corinth. When the Dorians, who were members of that confederacy, invaded and conquered Peloponnesus, they communicated that name, which themselves had adopted before they left their original seats, to the inhabitants of their new conquests ; and now all the Grecian tribes without distinction became Hellenes. At length the epithet of Barbarians, which at first comprehended only the tribes in the neighbourhood of the Hellenes who did not accede to the alliance represented by the Amphictyones, was extended to all the nations unconnected with the Hellenic tribes.

To conclude ; the Hellenes were not a particular race of people, nor were they denominated from HELLEN, the fabulous son of DEUCALION. They were a sect of idolaters, peculiarly addicted to the worship of the sun, who was, in some of the eastern dialects, called *Hel-En*, i. e. *the fountain of light*. They were found in Babylon, in Midian, in Arabia on the confines of Egypt, and more particularly in Egypt itself, where there were seminaries of learned men called Hellenes. From one of these sacerdotal seminaries, established at Thebes or Diopolis, emigrated the leaders of the colony of Helladians, which settled in the neighbourhood of Dodona. These built the city of Hellas, and from them the canton which they possessed.

was called Hellopia. They likewise built the temple and instituted the oracle of Dodona, under the protection of the Pelasgi, who had emigrated from the same quarters, and who at that time were masters of that region. As these Hellenes must have transported themselves to their new settlements on board Phœnician vessels, a goodly number of Phœnicians must have joined them, and mingled with them in Hellopia and its vicinity. Hence most of the names of persons, offices, places, &c. connected with the temple are evidently of Phœnician original. In process of time, a new colony emigrated from Hellopia into Phthiotis, a small district toward the south of Thessaly, where they built the city of Hellas, and where they still retained their original name. These new colonists brought along with them all the arts, culture, politeness, &c. which their ancestors had imported from Egypt and Phœnicia, at that period the most highly civilized countries upon earth. These new settlers, in consequence of their superiority in arts and arms, and the benefits their more eminent accomplishments enabled them to confer, easily gained the ascendant among the neighbouring Thessalians, who were at that time a race of barbarians. The prospect of sharing these advantages allureth the neighbouring tribes either to join or submit to them, and rendered them ambitious of the honour of being called by their name. The original Hellenes had learned from their Egyptian countrymen to brand with the name of barbarians all who did not speak the same language with themselves. This epithet the vain-glorious Hellenes liberally bestowed upon all the neighbouring nations which were too proud or too obstinate to court their alliance. It appears from the example of the Athenians, that the dread of being branded with this epithet contributed not a little to draw the adjacent people into a confederacy with the Hellenes. The institution of the Council of the Amphyctyones under the auspices of the Hellenes completed their triumph; and the dread

dread of being swallowed up by the oriental colonies which were from time to time arriving in Greece, engaged all the petty dynasties in the neighbourhood to solicit admittance into that confederacy. At first this association consisted only of twelve petty states, and reached from the southern confines of modern Thessaly to the Isthmus of Corinth. When the Dorians, who had been included in the Amphyctyonic league, and had consequently adopted the name of Hellenes, fell into Peloponnesus, and made themselves masters of the greatest part of that country, they communicated their name to their new subjects; so that, in process of time, the original name *Graii* was abandoned and forgotten, and all the tribes of the Greeks became *Hellenes*; a name which they retained as long as the nation existed. Hence, in process of time, all mankind came to be divided into *Ἑλληνες καὶ Βαρβαροι*, "Greeks and Barbarians."

END OF THE DISSERTATION.

APPENDIX CONCERNING THE AMPHICTYONES.

THOUGH I have omitted the explication of the council of the Amphyctyones in the body of the preceding dissertation, in order to avoid prolixity, I shall here add a few strictures upon that subject.

It was observed in the foregoing paper, that the Greeks ascribed the institution of this council to AMPHICTYON. This Prince, according to them, was the son of DEUCALION, and

the brother of the far-famed HELLEN, though some pretend that he was his son. The Athenians, who arrogate every thing to themselves, assert, that he was one of their Sovereigns. They tell us, that he came to Athens, and married the daughter of CRANAUS, the second King of Athens *. This unnatural Prince dethroned his father-in-law, and usurped the Crown. He reigned eleven, some say twelve years †, and was in his turn expelled by ERICHTHONIUS. According to APOLLODORUS, some were of opinion, that this same AMPHICHTYON was not the son of DEUCALION, but a native of Attica ‡; and if ever such a person did actually exist, I should imagine the latter opinion by far the most probable. But in either case, nothing can be more absurd than to suppose, that a petty sovereign of a territory, situated at a considerable distance from the centre of union, and unconnected with all the other states engaged in the confederacy, should have been possessed of sufficient influence and authority to accomplish an enterprise of such magnitude and importance. The very idea carries inconsistency in its aspect. This claim we must therefore place to the account of Athenian vanity.

SOME have ascribed the institution to ACRISIUS, King of Argos §, a position still more improbable, if possible, than the former. That Prince was too inconsiderable, and lived at too great a distance, to have projected such a plan, or, if he had, he could never have carried it into execution. What could have induced a Sovereign of Argos to interest himself in the concern of a temple so remote from his own dominions? What motive can we imagine could have engaged ACRISIUS to project an institution calculated to promote the union and security of a number of tribes with which he was altogether unconnected?—an institution from which neither himself nor his subjects

* APOLLOD. Bib. cap. iii. p. 221. PAUSAN. in Att. cap. 2. p. 7. bottom.

† Id. ib. ‡ Id. ib. § STRABO, Eb. ix. p. 420.

subjects could ever hope to derive the smallest advantage. The opinion which attributes this establishment to the wisdom and penetration of the Argive Prince, is therefore, in all respects, baseless and nugatory.

ANDROTION, quoted by PAUSANIAS*, appears to me to have given the genuine account of the institution of this celebrated council : Ανδρωτίων δε ει τη Ατθίδι, εφη, συγγενόη, π. τ. λ. " But ANDROTION, in his History of Attica, tells us, that from the most early period, deputies from the neighbouring states assembled at Delphi, and that these deputies were, from that circumstance called *Amphictyones*, and that consequently, in process of time, this became the prevailing designation of that high court." However this author may be mistaken in his etymology, he is certainly orthodox in his opinion relating to the original of this renowned assembly. It was an original institution. It did not derive its primary existence, either from AMPHICHTYON or ACRISIUS, or indeed from any particular person. It was a convention το εξ αρχης. It existed from the earliest ages of antiquity.—Let us now see whether it is not possible to give at least some probable account of its primary erection.

As the Hellenes had founded the oracle of Dodona, so the same people, in all probability, established the oracle of Delphi. They had seen the amazing credit and success of the former, and expected the like reputation and aggrandizement of the latter. The event proved, that the conjecture was founded in reason and sagacity. The renown of the Delphic erection in a short time eclipsed that of the fane of Dodona. The Greeks, who have ever been distinguished by their itch for novelty, quickly resorted in crowds to this newly erected office. In a few years, the temple became flourishing and opulent. The Delphic Pythoness, tutored by the Hellenes, uttered her mysterious predictions with such superior sagacity, that the events, in many instances, verified their divine original, or at least

least were imagined to do so by the deluded votaries. The responses were generally conceived in such equivocal terms as left it in the power of the Hierophant to explain them in such a manner as might save the credit of the Pythian god, be the issue what it might. Numberless fables were circulated among the Greeks, with relation to the portents and prodigies which prompted the people in the neighbourhood of Parnassus to erect this sacred edifice, and which attended the erecting of it. For my own part, I am fully convinced that it was a Hellenic establishment, founded by the emigrants of that colony from the neighbourhood of Dodona, and actually copied from that oracle. Such changes were probably made as experience had pointed out for a course of several ages, during which the mother Oracle had been in reputation. I mean not to compile a history of this oracle; my intention is only to shew, that the institution of the council of the Amphictyones is actually connected with this oracular establishment.

THE concourse to the temple of Delphi soon became immense. Its situation was happily chosen for that purpose*. It lay nearly in the centre of those petty tribes which afterwards formed the Amphictyonic association. These states, as was observed in the dissertation, became jealous of the growing power of the oriental colonies. Delphi appeared to them a convenient place for holding their conventions, agreed upon in order to concert measures for their mutual security. Both its sanctity and centrical position pointed it out as a place altogether

* STRABO, *ubi supra*. It lay nearly in the centre of Greece, but the Greeks entertained an opinion, that it was situated in the centre of the world—*ουρανός της οικουμένης*, the navel of the habitable world. So STRABO, lib. ix. p. 419. SOPHOCLE. in OEDIP. TYR. EURIP. in MEDEA. et alibi. PLUT. de defect. Orac. sub Init. PAUS. lib. x. p. 835. PIND. Pyth. iv. 6. It was originally called Lycoræa. Two Egyptian words compose it. *Aur* in many languages signifies light, and *Ω* signifies the Sun.

ther fitted for that purpose. The Hellenic Prefects of the temple, superior to the Barbarians in political skill and sagacity, would strain every nerve to promote a scheme calculated to advance both their honour and their interest.

IN all ages, and in all countries, to partake of the same common sacrifices has been deemed an infallible sign of amity and concord. First of all, then, the confederates assembled at Delphi, at certain stated seasons, to offer sacrifices, and perform other religious rites in name of all the associated tribes *. This was the most indissoluble bond of their fœderal union. Upon these public and solemn occasions, magnificent donations were offered to the Pythian god, and his ministers no doubt shared largely in these munificent effusions of devout liberality. As in consequence of these public donations, and the bountiful largesses of private individuals, who crowded from all quarters to consult the oracle, the treasury of the temple became exceedingly rich, the confederates imagined, that it concerned their honour, and perhaps their interest, to appoint officers to superintend that treasure. STRABO tells us expressly, that this was one of the ends of the institutions of the Amphictyones †. *Kai τε ιερος, κ. τ. λ.* "And they were to have the superintendency " of the temple in a more public capacity, which, as there was a " prodigious mass of treasure and donations deposited in it, " needed to be carefully watched and hallowed with purity." Thus it appears, the the original Amphictyones were a kind of wardens of the temple of Delphi, elected by the suffrages of the confederated tribes.

IN

* See HEROD. lib. i. Ephesus, and the temple of DIANA there, was the centre of union among the people of Lesser Asia, and we find that TARQUINIUS PRISCUS projected a like centre of union among all the petty states of Latium. CÆSAR informs us, that the Gauls had a like centre of resort in the territory of the Carnutes, where the Druids assembled once a-year to offer sacrifices in name of all the communities of Gaul.

† Lib. ix. p. 420.

IN process of time, it was imagined, that another class of officers should be added to the former, whose province it should be to watch over the civil interests of the confederacy. These two classes of superintendents gradually coalesced into one, and both united in discharging the sacred and civil functions annexed to their office. Each of the confederated states sent two deputies, without any regard to its extent or populousness. The one was denominated *Ιερούμενον, Hierumenon*, and the other *Πυλαγόρας, Pylagoras*. The former was chosen by lot, and his business seems to have been more immediately to inspect and superintend matters relating to religion, such as sacrifices, auguries, rites, ceremonies, &c. These officers I take to have been a part of the original constitution. The latter was elected by a plurality of voices, and his province seems to have been originally confined to the civil department. Both these had an equal right to deliberate upon, and vote in all matters that came before the assembly.

THESE stated times of assembling were twice in the year, once in spring, and once in autumn. Their spring meeting was called *Εαρινον πυλαιον*, their autumnal *Μετωπαινον*. The reason of this appellation was, according to the writers of Greece, owing to their having been originally instituted at *Pylæ*, afterwards called *Thermopylæ*. The duration of their sitting was not limited, but extended in proportion to the multiplicity, magnitude, or difficulty of the business which came before them. Before they entered on business, they jointly sacrificed an ox, cut into small pieces, which was a sacramental symbol of their amity and concord. Though their ordinary place of meeting was at Delphi, they sometimes adjourned to Thermopylæ. But this only happened when that city was threatened with a hostile invasion, or when the exigencies of the communities made the latter a more commodious station. When they assembled at Thermopylæ, they held their sessions in the temple of CERES, near the mouth of the river Asopus. The fifth epi-

tha of the Arundelian marbles, marks the institution of this council.

THE Amphictyones, before they began their deliberations, were obliged, as we learn from *ÆSCHINES*, to take the following most dreadful oath. "I swear never to overthrow any of the " cities which enjoy the privilege of sending deputies to this " council; never to divert the course of any river, either in " peace or war. If any people shall come with any such de- " sign, I engage to carry war into their country, to raze their " cities, boroughs, and villages, and to treat them, in all re- " spects, as my most implacable enemies. If any shall be " found so impious as to dare to rob the temple of APOLLO at " Delphi of the rich donations laid up there, or to favour such " an attempt, to employ all my efforts, with hands, feet, and " voice, to inflict vengeance on the sacrilegious wretch." This oath was accompanied with a most dreadful imprecation against those who should violate or falsify it. The imprecation was conceived in the following terms: "If any man shall violate this " oath, be he private man, city, or people, may he feel the ven- " geance of APOLLO, of DIANA, of LATONA, of MINERVA the " Provident! May his lands yield no fruit! May their wives, and " even their cattle, bear nothing but monsters! May the facri- " legious wretches lose their law-suits! May they be vanquished " in battle, and finally perish, themselves, their houses, and " all their offspring! Let their sacrifices never be accepted by " APOLLO, DIANA, MINERVA the Provident! May these deiti- " ties abhor their vows and their offerings!" Let us now see with what powers and privileges this august assembly was invested.

No private causes were determined by this court. These were deemed too trivial and uninteresting to engage the deliberation of this august convention. Their functions were partly of a sacred, and partly of a civil complexion. The former have been elucidated in the preceding pages. As civil magistrates, they

they were employed in maintaining peace and concord among the confederated states, by opposing such injuries as they mutually committed against each other ; by determining such disputes as might arise between neighbouring people, with relation to their boundaries, possessions, privileges, claims, jurisdictions, &c. ; by concerting such measures as they deemed necessary for maintaining the general confederacy. They endeavoured to protect the weaker states from the oppression of the more powerful ; to determine the causes and nature of complaints ; to redress public grievances of every description, and to promote every project that might conduce towards advancing the public weal, tranquillity and prosperity. In short, all public differences among the confederates, whether relating to matters of peace, of war, or of religion, fell under the cognizance of this venerable court. Its decisions were signed by the high-priest of Delphi, after which they were received with the deepest veneration, and engraved upon pillars of marble, in order to be preserved as authentic monuments. We meet with frequent instances of the power of this court in the Grecian history. Even the Phoenicians, the very people among whom it was first erected, felt, in latter times, the dreadful effects of its power and resentment.

WE are assured, that the cantons associated in the Amphictyonic league were twelve in number, and yet no author that I have had an opportunity of consulting mentions more than eleven. The reason, I believe, is this : The name of the Hellenes, who were originally at the head of the association, was, in process of time, absorbed by that of the Thessalians. According to ÆSCHINES, the confederacy consisted of the Thessalians, the Boeotians, the Dorians, the Ionians or inhabitants of Attica, the Perrhaebians, the Magnetes, the Locrians, the Oeteans, the Phthiotes, the Maleans, and the Phoceans. HARPOCRATION names likewise eleven ; the Dorians, the Ionians, the Perrhaebians, the Boeotians, the Magnetes, the Acheans, the

Maleans, the Dolopes, the Ærianes, the Delphians; and the Phocians. PAUSANIAS enumerates only ten; the Iones, the Dolopes, the Thessalians, the Ærianes, the Magnetes, the Maleans, the Phthiotes, the Dores, the Phocians, the Locri, who bordered upon Phocis under Mount Cnemis. The reason of this diversity probably arises from this circumstance: Some of the confederated states might assume new names, and some states might be struck out of the alliance, in consequence of some misdemeanour, and others substituted in their room.

SUCH was the fair-famed Council of the Amphictyones; a tribunal which reflects immortal honour upon Greece; and demonstrates the wisdom, sagacity and political talents of the Hellenes, who established so noble and so useful an institution. Happy, had it been invested with power sufficient to check the ambitious enterprises of some of the confederated states, which formed projects for reducing the rest to a state of dependence and servitude. Had its members been always animated with a spirit of peace, of justice, and good order, it would have rendered itself for ever respectable, and the associated states under its direction should never have become a prey to the once despised Macedonians.

STRABO pretends, that the college of the Amphictyones was abolished with the Achæan league. But PAUSANIAS mentions it as existing in his time, and as consisting of thirty constituent members. Nicopolis, Macedonia, and Thessaly, sent two a-piece. The Bœotians, Phœceans, and Delphians, sent each two members. One was furnished by the ancient district of Doris. The Ætolians, called Ozoli, and the people beyond the strait of Eubœa, sent one member each. The Eubœans and the Athenians furnished each one delegate.

AFTER the conquest of Greece by the Macedonians, this tribunal was shorn of its primitive lustre. AUGUSTUS too made some new regulations with respect to the states which

were invested with the privilege of sending deputies to that Council. Though it subsisted in the days of PAUSANIAS, who flourished under ANTONINUS PIUS, it was probably of so little repute, in the age of STRABO, that this geographer looked upon it as in a manner annihilated.

END OF THE THIRD VOLUME.



E R R A T A.

PHYSICAL CLASS.

- Page 27, line 20, for fourteenth, read sixth
45, 21, for concave lens of a dispersive fluid,
read convex lens of a dispersive fluid
50, 21, for then, read there

LITERARY CLASS.

6,	ligne 25, commencé,	l'iesx commencée
7,	19, de,	du
7,	21, put,	pu
8,	5, remplis,	remplies
10,	15, qui,	que
11,	4, avoit,	avois
11,	17, lorque,	lorque
11,	31, je pu,	j'ai pu
12,	9, paffa,	paffai
12,	14, architects,	architec̄tes
12,	16, fut,	fus
12,	21, détaché,	détachés
12,	24, suivie,	suivi
12,	26, leurs,	leur
13,	17, n'est,	n'eut
14,	4, seond,	seconde
14,	6, de,	des
14,	10, et,	est
22,	4, quit,	qui
22,	17, elle,	elles
22,	21, une,	un
24,	33, permit,	permets
25,	16, quoique à,	quoiqu'à
26,	16, renoncé,	renoncer
27,	8, je,	je le
27,	20, s'écumant,	écumant
27,	32, azure,	azuré
28,	21, mediocre,	mediocres
30,	7, le longue,	les longs.
30,	14, m'avez,	m'avoit
30,	15, fois,	foi
34,	1, d'épreuve,	de preuve
37,	27, cette,	cet
38,	4, les princes,	les grands
42,	22, application,	explication
43,	8, Grecque,	Grecque
49,	8, designée,	designée
50,	2, put-on,	plut-on
51,	30, à rien,	à ne rien
54,	23, à,	de
57,	23, l'ignoré,	l'ignorer
57,	30, d'une,	d'un
61,	8, espace,	espace
89,	6, interieurs,	interieures

- Page 111. line 25. for his doing do read his doing so
113. — 24. between saltuum and frontesque insert scrutaretur
125. — 1. for pratio read pralio

DIREC̄S.

DIRECTIONS FOR THE BINDER.

The Binder is desired to observe that the Vol. consists of Three Sets of Pages, to be arranged in the following order, immediately after the TABLE OF CONTENTS, viz. PART I. containing the HISTORY OF THE SOCIETY : PART II. containing, I. PAPERS OF THE PHYSICAL CLASS ; II. PAPERS OF THE LITERARY CLASS : And to observe with respect to the PLATES as follows, viz, that there are in all 24; viz. 15 for the PHYSICAL CLASS, and 9 for the LITERARY CLASS : Which are to be placed exactly according to the references marked on the corner of each.

N. B. Five of the Plates have been cast off without the above mentioned references, by omission of the Engravers. Place these as follows :

Those marked { TAB. I.
TAB. II.
TAB. III.
TAB. VI. [for TAB. IV.] } all to face p. 264. Phys. Cl.

That entitled—CARTE de l'ancienne TROIE, &c. to face p. 72. Lit. Cl.

